

# SERVICE MANUAL

THE  UNDER



**HAMMOND ORGAN COMPANY**  
**DIVISION OF HAMMOND CORPORATION**

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SOUNDER -

Cabinet Size 33½" Wide, 21½" Deep, 38" High With Music Panel

Weight: 125 Lbs. With Bench

Power Input: 120 Volts, 60 HZ., .5 Amps

Power Output: One Channel, 10 Watts



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# SECTION I

## HOW THE ORGAN OPERATES

### SOUNDER - 100100 SERIES

#### GENERAL PERFORMANCE DESCRIPTION

##### 1-1 GENERAL.

This section contains a brief description of the organ. The instrument is of a chord organ type, having a 37-note keyboard and 24 chord buttons.

##### 1-2 CABINETRY.

The 100112 is a full case design with traditional styling. The 100122 having contemporary styling will also be available.

##### 1-3 TONE SOURCE.

The Sounder's tone-generating system utilizes a multi-derivative divider (MDD) system, driven by a master oscillator subject to transposing, portamento, and vibrato. Twenty-four dividers in several I.C. packages produce the second and third octaves of tone for A.C. keying. These two octaves are stairstepped prior to keying and tonally match the harmonic content of the MDD outputs.

##### 1-4 TRANSPOSER SLIDER.

This slider control transposes the musical generating system up and down in a wide range, C to C. The organ sound best in the middle of the range setting. The slider set in the upper end of the range is considered normal and the low end as being one octave down from normal.

##### 1-5 MANUAL.

The Sounder has a 37-note keyboard, the keys are in modules or sections. There is an actuator under each key and when a key is depressed, the actuator is compressed against a conductive strip which in turn is pressed and makes contact with the keyboard printed wiring board. This provides means of switching and keying the dividers.

##### 1-6 TAB VOICING.

The keyboard output at a single pitch is subject to four voice filters. The voices are flute, string, horn, and reed. By depressing tab or tabs, the voices may be used singly or in any combination.

##### 1-7 REPEAT PERCUSSION.

Depressing the repeat tab engages the repeat mode, a slider type control varies the repeat rate from approximately 2 to 15 hertz. The repeat is touch response triggered.

##### 1-8 VIBRATO.

A slider type control varies the vibrato width smoothly from zero (or no vibrato) to maximum, which is somewhat wider than normal. The vibrato rate is 6.6 hertz.

##### 1-9 CHORD BUTTON ASSEMBLY.

There are three rows of chord buttons, first row provides the major chords, 2nd row the minor chords, and 3rd row, sevenths. The major and minors

are all 3-note chord combinations and 4-note for the sevenths. The bass notes sound two octaves lower than the root and fifth of the selected chord.

The chord tone has a filter which voice is similar to a diapason. Tones are stairstepped after keying.

#### 1-10 AUTOCHORD.

Autochording is heard by first; depressing and turning on the auto-chord button or knob, -select and depress rhythm pattern, -and adjust tempo, -depress chord button and autochording sounds.

When autochording is on, the root and bass notes are alternately and percussively sounded along with the chord tone in the pattern and tempo of the selected rhythm.

When autochording is off, the root bass note sounds constantly with the chord button depressed.

#### 1-11 AUTOMATIC RHYTHM.

The rhythm section produces five rhythm patterns, waltz, rock, ballad, and Latin. Patterns are single measure and have eight time divisions within the measure. There are four voices; bass drum, snare drum, claves, and brush and cymbal. The root bass note sounds on every first beat and the fifth bass note sounds on every third beat for every rhythm pattern except the waltz.

#### 1-12 TOUCH CONTROL.

When the touch knob is depressed or "on", the rhythm sound is heard only while a chord button is depressed, and it starts with beat one. Prior to depressing a chord button, the tempo lamp is flashing at beat rate. When the rhythm runs continuously and the lamp flashes at measure rate. The volume slider silences the rhythm

sound, but the lamp will continue to flash.

#### 1-13 PORTAMENTO.

The portamento button is placed conveniently for thumb operation in the chord button assembly. It is readily identified by a contrasting color. When the portamento button is depressed, the pitch of the entire generator instantly drops one semi-tone and stays. When released, the pitch smoothly returns to normal in about a half second.

#### 1-14 EXPRESSION PEDAL.

The combined outputs are controlled by the expression pedal. The assembly is of the block module design utilizing a single channel.

#### 1-15 HEADPHONE JACK.

A standard  $\frac{1}{4}$  inch jack mounted on the front face of the speaker baffle near the top. It has the contact complement, which connects a monaural signal onto a three contact, stereo-wired headphone plug. Suitable decoupling prevents shorting out the signal if a mono jack is used. Inserting the headphone jack silences the organ output.

#### 1-16 AMPLIFIER.

The output system uses a 10 watt single channel amplifier along with a 12-inch speaker.

## SECTION II DISASSEMBLY AND MAINTENANCE



# DISASSEMBLY

SOUNDER - 100100

2-1 GENERAL-Steps 2-2 thru 2-21 provide instruction for disassembly of the 100112 series "Sounder" organ. This procedure is layed out in a disassembly sequence. Reverse procedure for reassembly. For access to any specific component or assembly, it may be necessary to use combinations of several of these steps.

## DISASSEMBLY SEQUENCE

To Remove or Replace An Assembly.

### 2-2 REMOVE REAR COVER (BACK)

- A. Remove five (5) screws on each side of the upper section of back cover, and one (1) in the upper center.
- B. Lift back up and away from organ.

### 2-3 REMOVE MUSIC PANEL

- A. Music panel should be lifted at approximately a 45° angle up and toward the rear of organ.
- B. To replace-locate two (2) pins on the bottom of the music panel. Holding panel at approximately a 45° angle, insert pins into the two (2) holes drilled into organ top and seat music panel.

### 2-4 REMOVE TOP PANEL

- A. Remove back cover and music panel as explained in steps

2-2 and 2-3.

- B. From rear of organ, located near the top, is a wood rail that is across the width of the organ and is joined to the sides. About 8" away from each side and under the rail, locate screws that go thru the rail and fasten into top panel. Remove these screws. Top is now loose.
- C. Slide top toward the rear, lift and remove. Careful not to loose fiber shims, they are used to level top panel when reassembling.
- D. To reassemble, place top into position to slide forward onto control panel assembly. Be sure top edge of control panel fits into slot in the top panel. Slide into place.
- E. Insert screws thru top rail and start screws into top panel. Do not tighten.
- F. Use fiber shims to level rear of top panel to sides of cabinet. Shims fit between top panel and rail. Tighten screws, securing top to rail.

### 2-5 TO REMOVE FRONT RAIL (FIGURE 1-A)

- A. From front of organ and under shelf, remove center screw fastening rail to shelf.
- B. Loosen cabinet legs by turning each leg counterclockwise approximately two (2) turns. DO NOT REMOVE LEGS. (See Figure 2-A)
- C. Slide rail off by pulling evenly away from organ shelf,

A  
LOOSEN LEGS TO  
REMOVE FRONT STRIP

A  
LOOSEN LEGS TO  
REMOVE FRONT STRIP

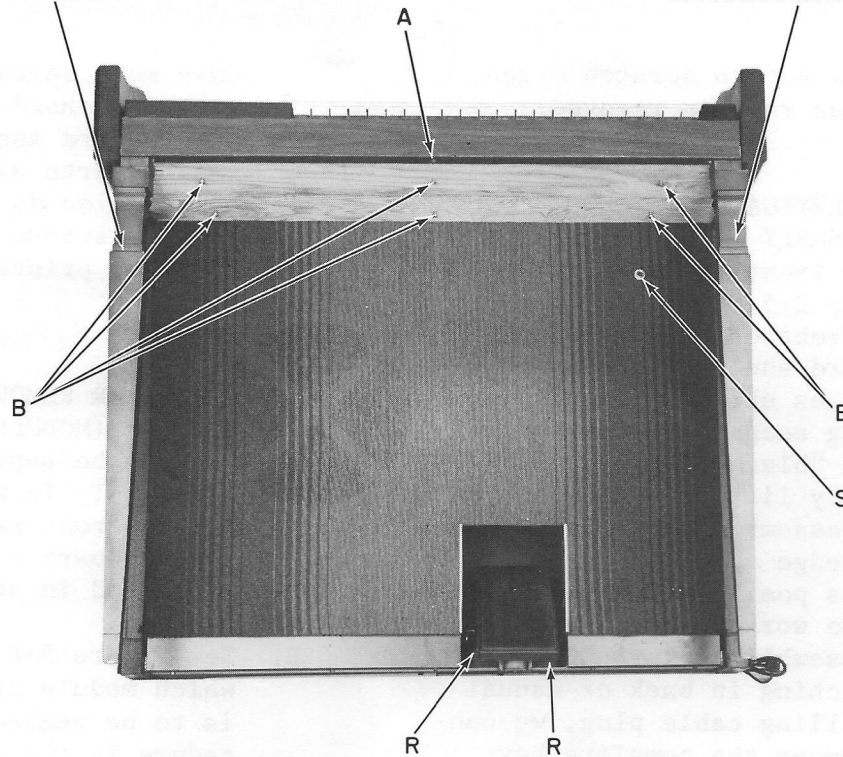
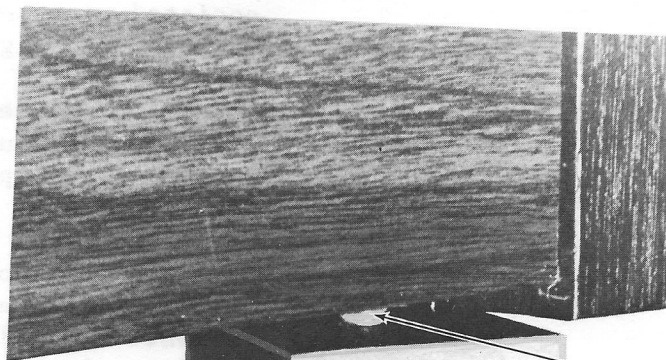


Figure 1



AS STATED IN 2-5,B  
LOOSEN CABINET  
LEGS BY TURNING  
EACH LEG CLOCK-  
WISE APPROX. TWO  
(2) TURNS. DO NOT  
REMOVE LEGS.  
WHEN FRONT STRIP  
IS REPLACED, RE-  
TIGHTEN LEGS.

TO  
LOOSEN

Figure 2

careful not to scratch organ sides as rail is removed.

2-6 TO REMOVE KEYBOARD AND CHORD BUTTON ASSEMBLY

- A. Remove front rail as explained in step 2-5.
- B. From front of organ and under keyboard shelf, remove six (6) screws as shown in Figure 1-B.
- C. Holding each end of keyboard at the "black" end blocks, slightly lift and pull the complete assembly forward to the front edge of manual shelf. In this position you will be able to work on the chord button assembly or keyboard.
- D. By reaching in back of manual and pulling cable plug, we can now remove the complete keyboard and chord button assembly.
- E. Reassemble by reversing procedure.

2-7 TO REMOVE CHORD BUTTON ASSEMBLY

- A. Remove front rail and keyboard assembly as explained in steps 2-5 and 2-6.
- B. With complete keyboard and chord assembly removed from organ, remove two (2) screws from top rear of chord button assembly.
- C. From underside of chord button assembly remove two (2) screws shown on Figure 4-E.
- D. From top, lift slightly and slide chord button assembly to the left, unplugging chord assembly.
- E. By adding slight pressure at several points between cover and printed wiring board, you will separate the black plastic cover from the printed wiring board.
- F. Reassemble in reverse procedure.

Care must be taken when plugging chord assembly into keyboard assembly that mating parts align properly. Also do not over-tighten screws to plastic cover or printed wiring board.

2-8 TO REPLACE OR REMOVE ONE SECTION OF KEY (MODULE)

- (Key cannot be replaced individually, only in key modules.)
- A. Remove front rail and chord and keyboard assembly as explained in steps 2-5 and 2-6.
  - B. See Figure 5-F to determine which module or key section is to be removed. Procedure is the same to remove one or all key modules.
  - C. Locate module (key section) to be replaced. Remove all screws and clamp strip associated with section being removed, see Figure 5-F and 3-F.
  - D. When removing key sections, lift slightly and slide forward to clear upstop and downstop felts.
  - E. It is necessary to remove actuator from bottom of key sections. Actuators are the white plastic tabs which fit into slot in key channel, Figure 5-F. To remove compress ends and slip out. Each key must have an actuator. Before a key section is installed, be sure all actuators have been inserted by compressing end and fit into key slots. Reassemble key section to keyboard.

2-9 TO REPLACE KEYBOARD PRINTED WIRING BOARD

- A. Remove front rail, keyboard assembly and all key sections,



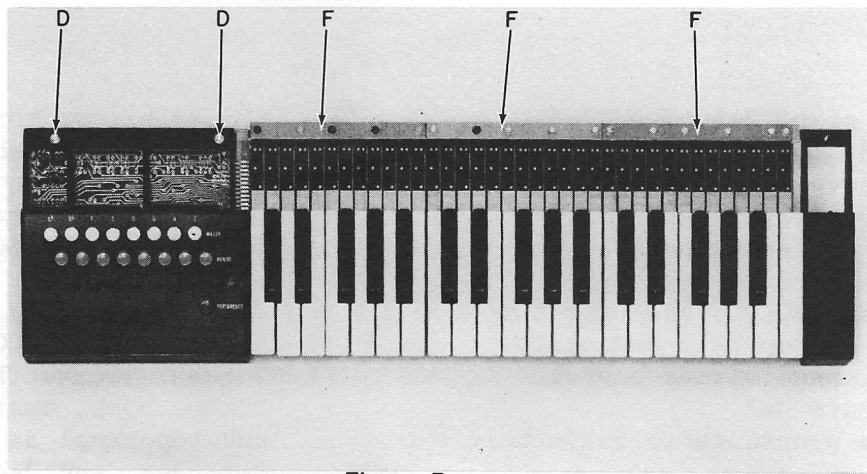


Figure 3

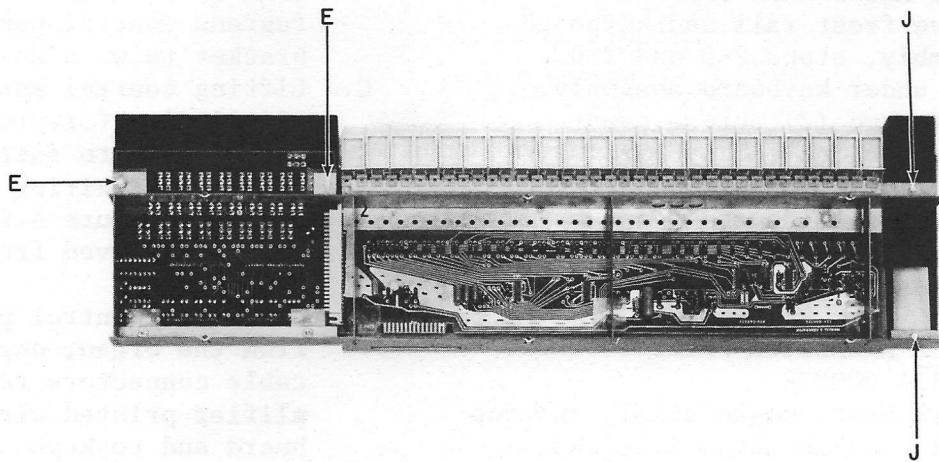


Figure 4

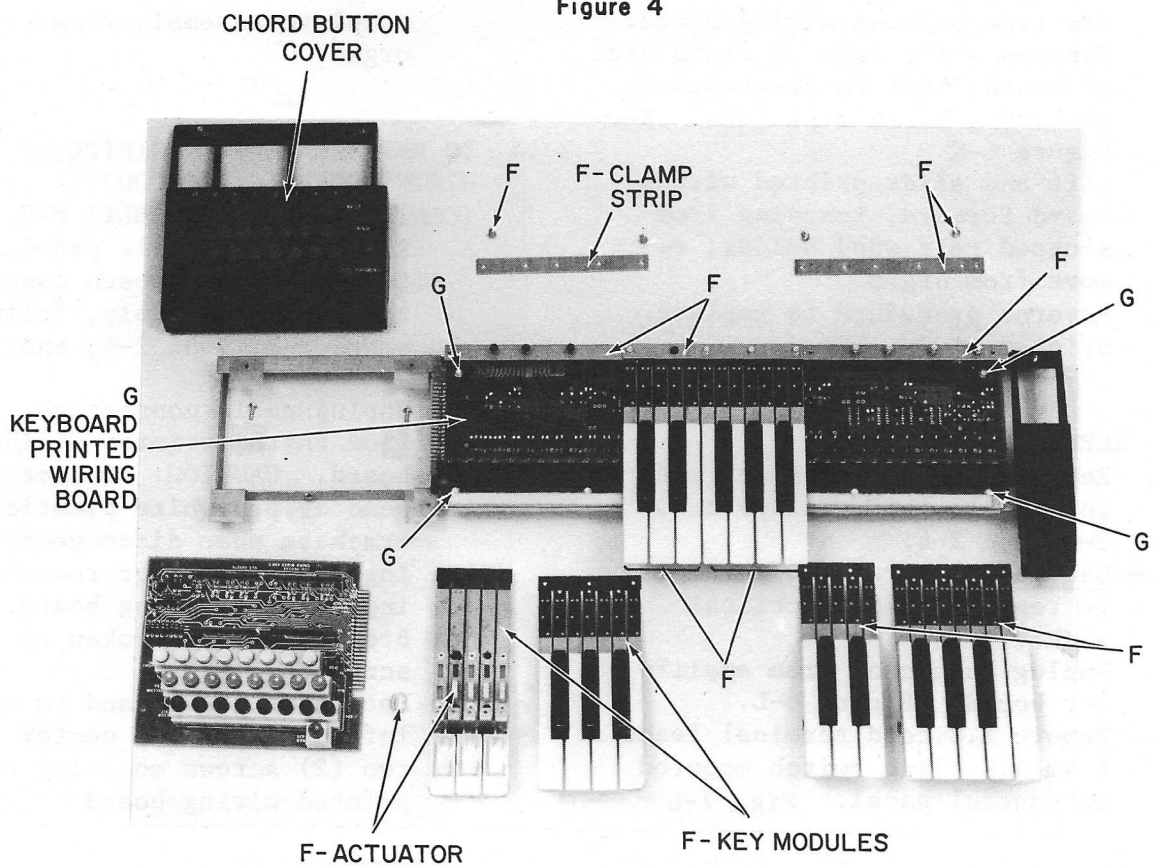


Figure 5

- follow steps 2-5, 2-6, 2-7, and 2-8.
- B. With above steps taken, proceed to remove eight (8) screws fastening printed wiring board to keyboard frame assembly. See Figure 5-G.
  - C. Remove upstop felt and strip from printed wiring board.
  - D. Lift board out.
  - E. Reverse procedure to reassemble.
- 2-10 TO REMOVE RIGHT HAND END BLOCK
- A. Remove front rail and keyboard assembly, steps 2-5 and 2-6.
  - B. From under keyboard assembly, remove two (2) screws mounting end block to keyboard assembly. Figure 4-J.
  - C. End block lifts off—reverse procedure to reassemble.
- 2-11 TO REPLACE AMPLIFIER PRINTED WIRING BOARD - 124-000338
- A. Remove back, music panel, and top panel, follow steps 2-2, 2-3, and 2-4.
  - B. Unplug three (3) cable connectors from printed wiring board.
  - C. Depress white tabs on front side of board, lift to clear printed wiring board over tabs. See Figure 6-K.
  - D. Lift and slide printed wiring board forward, removing from slotted rear wood holder, remove from organ.
  - E. Reverse procedure to replace printed wiring board.
- 2-12 TO REPLACE TRANSFORMER
- A. Remove back, music panel and top panel, follow steps 2-2, 2-3, and 2-4.
  - B. Caution—be sure A.C. cord plug is removed from electrical socket.
  - C. Unplug connector from amplifier board. Figure 6-L.
  - D. Remove A.C. cord terminal leads from A.C. line switch mounted in control panel. Fig. 7-L.
  - E. Remove screws mounting transformer to shelf. Figure 6-L.
  - F. Remove transformer, replace in reverse procedure.
- 2-13 TO REMOVE OR LOOSEN CONTROL PANEL ASSEMBLY (COMPLETE)
- A. Remove back, music panel and top panel as in steps 2-2, 2-3, and 2-4.
  - B. Remove two (2) screws each side of control panel that fastens control panel bracket to wood shelf.
  - C. Lifting control assembly and tilting forward will give access to switches and printed wiring board. Caution—be sure A.C. cord plug is removed from electrical socket.
  - D. To remove control panel from the organ, unplug cable connectors to amplifier printed wiring board and to keyboard.
  - E. Remove push-on terminals to A.C. line switch. Lift complete assembly from organ.
- 2-14 TO REPLACE RHYTHM PRINTED WIRING BOARD - 124-000337 (CONTROL PANEL ASSEMBLY) FIG. 7M,9M
- A. Remove back, music panel, top panel and loosen control panel assembly, follow steps 2-2, 2-3, 2-4, and 2-13-C.
  - B. Unplug cable connectors from rhythm printed wiring board. CAUTION: Do not bend or pry white plastic brackets when disconnecting cable plugs or removing printed wiring board. Bracket can be broken at screw head area.
  - C. Locate on top of and to the left and right of center two (2) screws mounting the printed wiring board

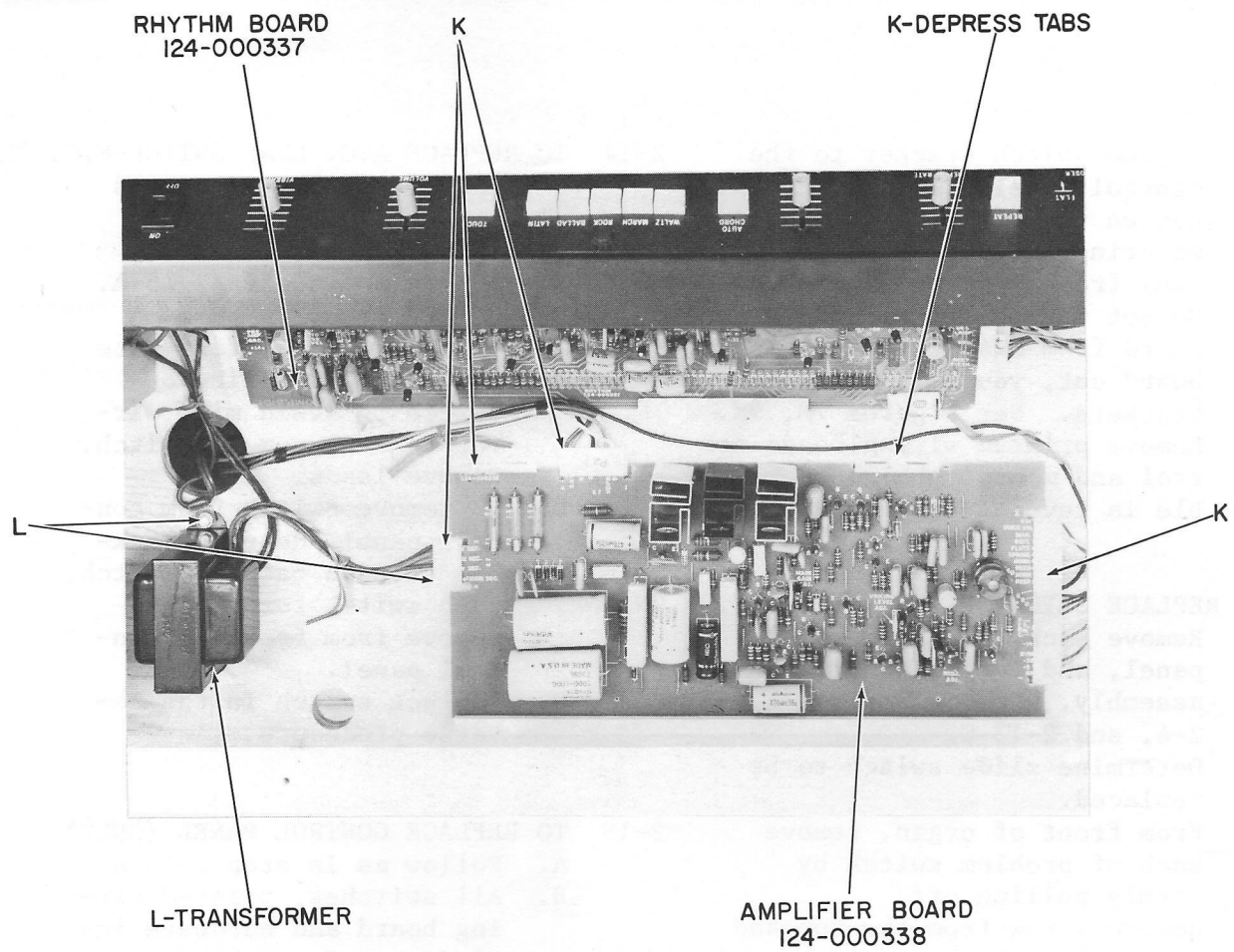


Figure 6

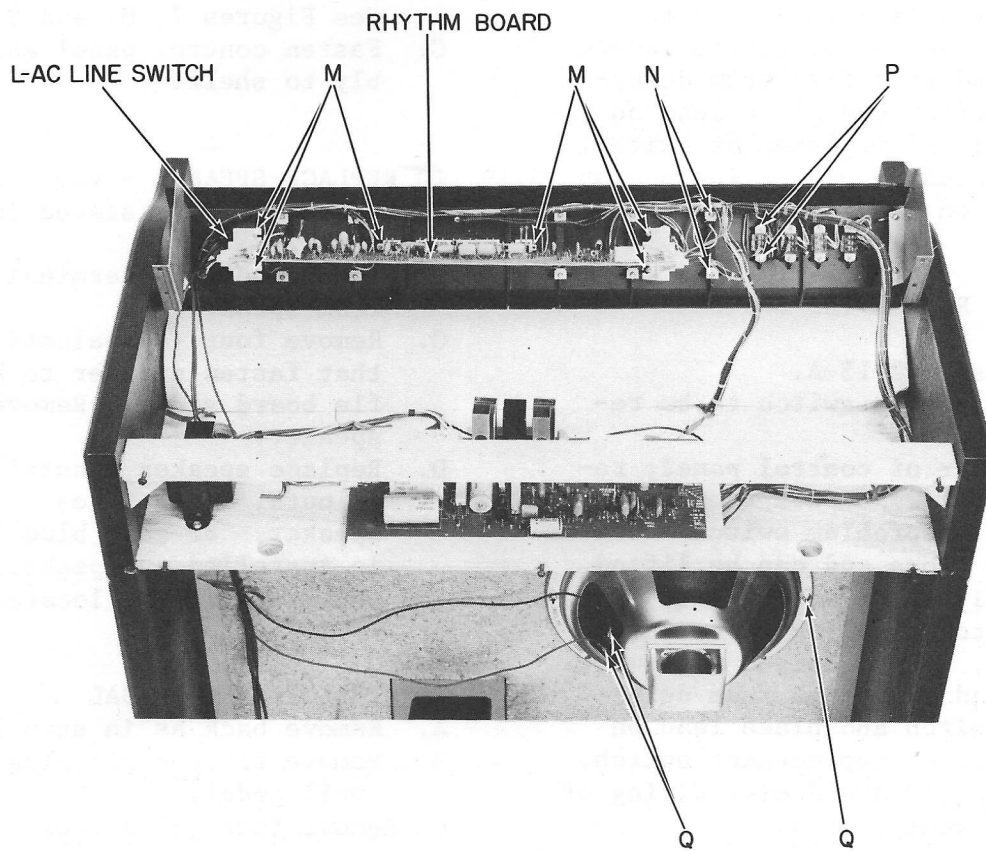


Figure 7



- rhythm switch bracket to the control panel. Remove screws.
- D. Loosen two (2) screws each side mounting white plastic brackets away from printed wiring board. Do not try to pry printed wiring board from bracket slot and slide board out, you will break the brackets. See Figures 7M, 9M.
  - E. Remove printed wiring board control and manual shelf. Reassemble in reverse procedure.
- 2-15 TO REPLACE SLIDE SWITCH - FIG. 7N, 8N, 9N
- A. Remove back, music panel, top panel, and loosen control panel assembly. Follow steps 2-2, 2-3, 2-4, and 2-13-C.
  - B. Determine slide switch to be replaced.
  - C. From front of organ, remove knob of problem switch by firmly pulling off.
  - D. Remove screw from the top and bottom of selected switch. Fig. 7N, 8N, & 9N. Switch is now loose and can be lifted slightly to be worked on.
  - E. If switch is going to be replaced, it is advised to remove one lead at a time from defective switch and place lead on same pin of replacement switch. This should avoid having a miss wiring on replacement switch.
- 2-16 TO REPLACE ROCKER TAB SWITCHES - FIGURE 7P, 8P
- A. As in step 2-15-A.
  - B. Determine tab switch to be replaced.
  - C. From rear of control panel, remove two (2) screws from top and bottom of problem switch. Switch is now loose and can be lifted slightly to be worked on.
  - D. If switch is going to be replaced, it is advised to remove one lead at a time from defective switch and place lead on same pin of replacement switch. This should avoid miss wiring of replacement switch.
- 2-17 TO REPLACE A.C. LINE SWITCH-FIG. 7L, 9L
- CAUTION: The A.C. line cord plug must be removed from electrical socket.
- A. Follow as in step 2-15-A.
  - B. Before removing push-on terminal leads, take note as to proper wiring of switch to avoid miss wiring to replacement switch. Remove leads.
  - C. To remove switch from control panel, depress locking tabs on back of switch, push switch forward and remove from front of control panel.
  - D. Replace switch in the reverse procedure.
- 2-18 TO REPLACE CONTROL PANEL (ONLY)
- A. Follow as in step 2-15-A.
  - B. All switches, printed wiring board and hardware including end brackets mounted to control panel must be removed and installed on replacement control panel. See Figures 7, 8, and 9.
  - C. Fasten control panel assembly to shelf.
- 2-19 TO REPLACE SPEAKER - FIG. 7, 8
- A. Remove back as stated in step 2-2.
  - B. Remove push-on terminal leads from speaker.
  - C. Remove four (4) palnuts that fasten speaker to baffle board studs. Remove speaker.
  - D. Replace speaker, install palnuts, connect leads to speaker. Be sure blue lead is installed on speaker lug where red dot is located.
- 2-20 TO REPLACE SWELL PEDAL
- A. Remove back as in step 2-2
  - B. Remove fifteen pin plug from swell pedal.
  - C. Remove four (4) screws

mounting swell pedal to bottom wood shelf. Fig. 1-R.

- D. From the front of organ, carefully pull assembly straight back, for swell base projects above and below bottom shelf. Reassemble in reverse manner.

## 2-21 TO REPLACE PHONE JACK-FIG. 1-S

- A. Remove back as stated in step 2-2.
- B. From front of organ, remove hex nut located on the upper right of baffle and grille assembly.
- C. Remove phone jack from baffle.
- D. As not to cause miss wiring of phone jack, remove one lead at a time from defective assembly and solder to replacement phone jack.
- E. Reassemble in reverse procedure.

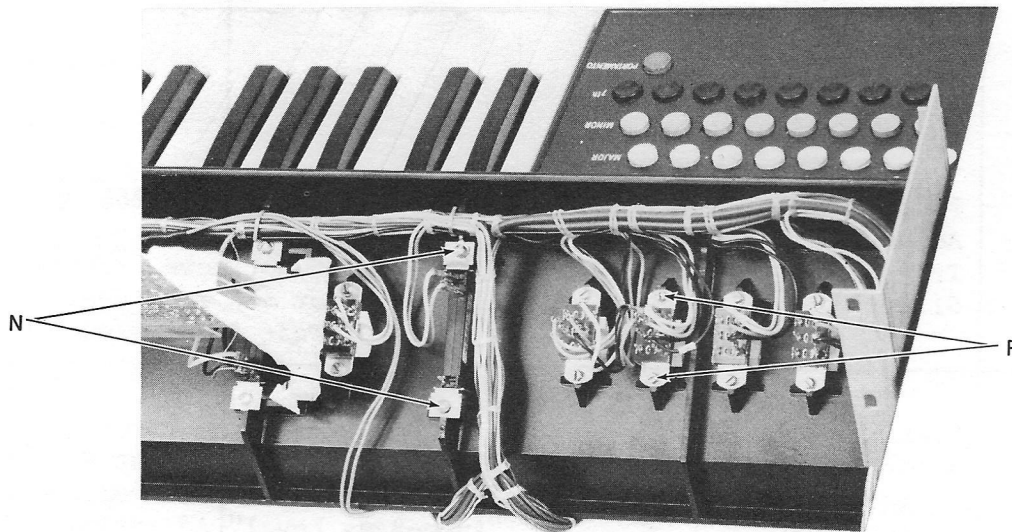


Figure 8

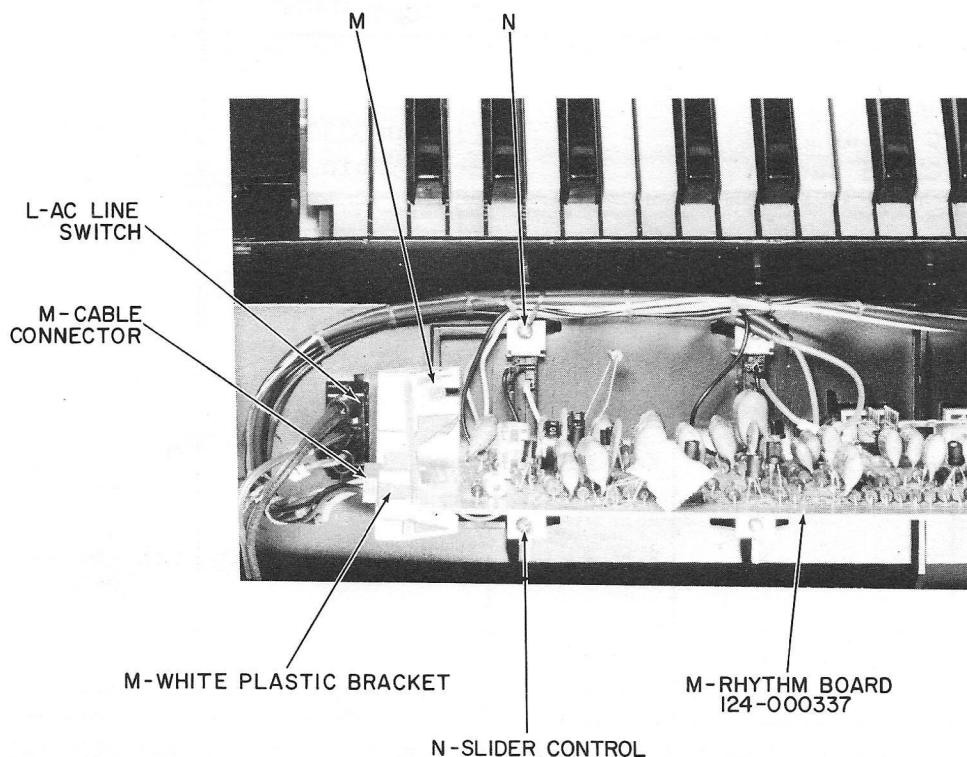


Figure 9

# TEST AND ADJUSTMENT PROCEDURES

## SOUNDER - 100100 SERIES

STEP	TEST AND TEST POINT	DEPRESS TAB OR MOVE SLIDER	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIG.
1	(a) <b>TRANSPOSER</b> Across Main Speaker	Flute Tab Transposer Slider to Bottom End	Key #1		(a) 93 to 119 HZ	
	(b)	Flute Tab Move Transposer Slide to Top End	Key #1		(b) 283 to 357 HZ	
	(c)	Flute Tab Adjust Transposer Slider	Key #1		(c) 260 HZ	
				NOTE: Do not move Transposer Slider for the remainder of the "Test & Adjustment Procedure".		
2	(a) <b>NULL ADJUST LEVEL</b> Ear and Ground Pin 4 of J5 plug on 124-000337 Board	Autochord "on" Ballad Rhythm Rate "on" Slider to Bottom end C Major Chord Button		(124-000337) Adjust R-75- "Auto-Bass Level" to Minimum, fully Clockwise  Adjust R-78 "Null" to Minimum Audible Thump	Adjust R-75 to Minimum before Adjusting R-78	
3	(a) <b>MAIN GAIN LEVEL</b> Across Main Speaker	C Major Chord Button		(124-000338) R-66 "Main Gain Adj."	(a) .8 Volts RMS	
4	(a) <b>VOICING LEVELS</b> Across Main Speaker	Tab Depressed Individually Flute	Key #1	(124-000338) R-34 "Voicing Level Adj."	(a) 3.3 Volts RMS	
	(b)	String (only)	Key #1		(b) .52 to .78 Volts RMS	
	(c)	Horn (only)	Key #1		(c) .66 to .98 Volts RMS	
	(d)	Reed (only)	Key #1		(d) .18 to .26 Volts RMS	

NOTE: During Test Procedure the following must be maintained unless otherwise stated:

A.) Expression Pedal depressed to maximum. B.) All tabs and slide controls in the

2-10 "up" (off) position. C.) Keys are called out by number left to right.

STEP	TEST AND TEST POINT	DEPRESS TAB OR MOVE SLIDER	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIG.
REPEAT-NULL ADJUST						
5	(a) Ear	Repeat Slider To Lowest Position	Key #1	(124-000338) R-48-"Null Adj."	(a) Adjust to Minimum Audible thump.	
	(b) Across Main Speaker	Add String "on"	Key #1		(b) 6.4 to 10.6 Volts P.P. 40 to 67 M Sec. at Maximum	
	(c) "	Move Repeat Slider to Highest Position String "on"	Key #1		(c) 6.4 to 10.6 Volts P.P. 700M Sec. to 1.2 Sec. at Minimum	
MINIMUM SWELL LEVEL						
6	(a) Across Main Speaker	Flute "on" Swell Pedal to Minimum Position	Key #1		(a) .42 Volts RMS	
VIBRATO						
7	(a) Ear	String "on" Move Vibrato Slider from Top to Bottom	Key #1		(a) Vibrato Should Increase Gradually from No Vibrato to a Normal Maximum Amount.	
	(b) Take Readings Only if Necessary at Junction of R-85 and R-5 on 124-000335 Board	String "on" Vibrato Slider to Bottom Position	Key #1		(b) 6.8 HZ 14 Volts P.P.	
PORTAMENTO						
8	(a) Ear	String "on", Vibrato to Top Position, Depress Portamento Button on Chord Button Assembly	Key #1		Note that the frequency decreases approximately 5.5%	
	(b)	Release Portamento Button			Tone Returns to its Original Frequency in .3 to 1. second.	

STEP	TEST AND TEST POINT	DEPRESS TAB OR MOVE SLIDER	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIG.
9	RHYTHM VOLUME					
	(a) Across Main Speaker	Rhythm Volume to Bottom Position Waltz "on"			(a) Bass Drum Voice 17 to 25 P.P	
	(b) Ear	Ballad "on"			(b) Observe Rhythm Pattern, Add Tempo Lamp	
	(c)	Depress Touch Button			(c) Note: Rhythm Pattern disappears and Tempo Lamp Flashes Approximately four times faster.	
	(d) Ear		Depress Any Chord Button		(d) Note: Rhythm starts on Down-beat and Tempo Light returns to Normal Rate.	
	(e) Across Main Speaker	Rhythm Volume Top Position	Depress C Major Chord Button	(124-000337) R-75-"Auto Bass Level"	(e) 1.6 Volts RMS Chord and Bass Note Heard Continuously	
	(f)	Ballad "on" Vary Rhythm Rate Slider Control from Lowest to Upper Position			(f) Tempo Varies Approximately 45 to 450 Beats per minute	
10	HUM AND NOISE LEVELS					
(a)	Across Main Speaker	Flute "on" String "on" Horn "on" Reed "on" Repeat "on" Rock "on" All Slider Controls to Uppermost Position			(a) 25 MV. RMS	



STEP	TEST AND TEST POINT	DEPRESS TAB OR MOVE SLIDER	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIG.
(b)	Across Main Speaker	As in Step 10a, and turn off Rock Also Move Rhythm Slider Volume to its Lowest Position			(b) 30 MV. RMS	
(c)	Across Main Speaker	Turn off Repeat All Voices Rhythm Volume to Highest Position	Depress any Key		(c) 30 MV. RMS	

## C A U T I O N

1. DO NOT USE ANY SPRAYS OR LUBRICANTS ON CHORD SWITCHES OF THE 124-000336 BOARD LOCATED ON THE LEFT HAND MANUAL END BLOCK.
2. WHEN REMOVING THE TOP FROM THE ORGAN, BE SURE YOU SLIDE THE TOP TOWARD THE BACK OF THE ORGAN BEFORE REMOVING IT TO PREVENT DAMAGE TO THE FRONT PANEL OF THE ORGAN.

## C O M M O N   P R O B L E M S

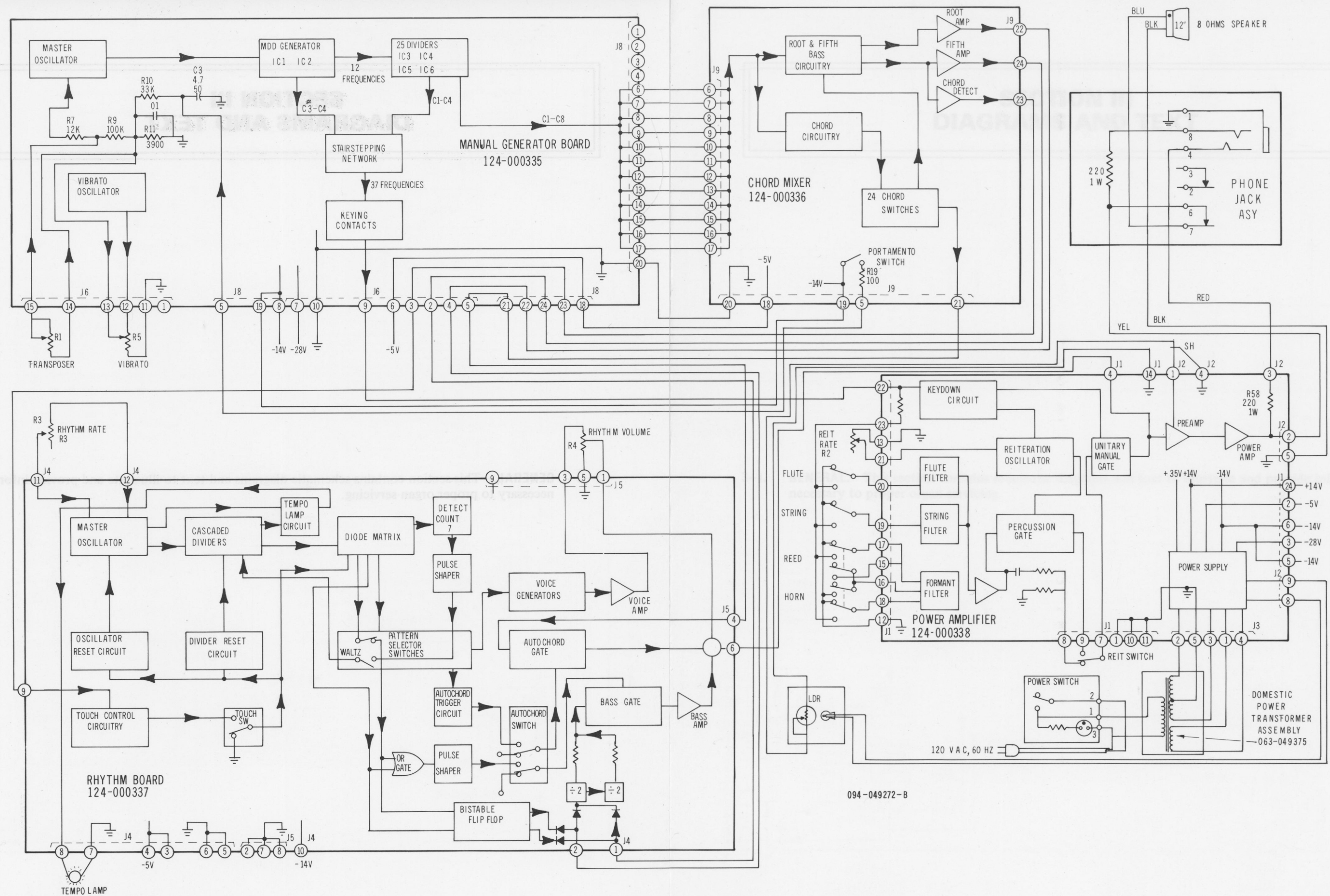
1. ELASTOMER STICKING - The elastomer is located on the 124-000335 board of the organ. It consists of two major parts which keys each individual key of the organ. The first component is the gasket which isolates each individual contact or contacts which involves the 37 keys of the manual. It enables the conductive elastomer to be placed on top of the gasket which is bonded by the adhesive material on the gasket. Upon depressing one of the keys on the manual, the elastomer is pressed through the space provided on the gasket to make contact with the contacts of the 124-000335 board. Upon making contact, the signal appears at the output pin of the 124-000335 board which is plug 6, pin 9. If the elastomer is sticking to the contacts of the board, it will cause the key to sound in the up or off position of the key on the playing manual. In order to repair or replace the conductive elastomer strip on the 124-000335 board of the organ, you must follow steps 2-6, 2-7, 2-8, and 2-9 of the disassembly procedure in order to come in contact with the conductive elastomer strip.
2. DEAD KEYS - In order to locate a dead key or keys you would follow the following procedure. The first step would be to follow the disassembly procedure (Steps 2-6, 2-7, 2-8, 2-9) to come in contact with the elastomer strip to make sure that the actuator on the key is depressing the elastomer strip properly. By pressing the elastomer with your finger, you can see if the elastomer is making contact properly. If the key is still dead, there has been an I. C. failure or a broken copper pattern on the 124-000335 board. If there is one key dead plus another key with a wrong tone or several keys dead, it will help in locating the proper I. C. which has failed by following the schematic in the service manual. The keys are numbered on the right-hand side of the schematic to help you follow the paths back to the I. C. which involves the key or keys that are dead on the manual.

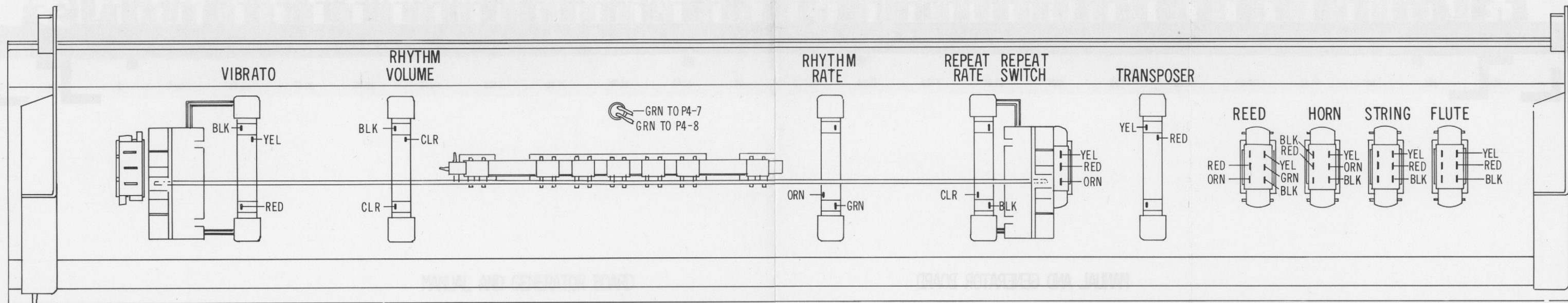
### SECTION III DIAGRAMS AND TEXT

- 3-1. **GENERAL.**— This section contains schematic diagrams and text to illustrate and provide information necessary to proper organ servicing.

FIGURE 3-1  
CONSOLE LOGIC DIAGRAM



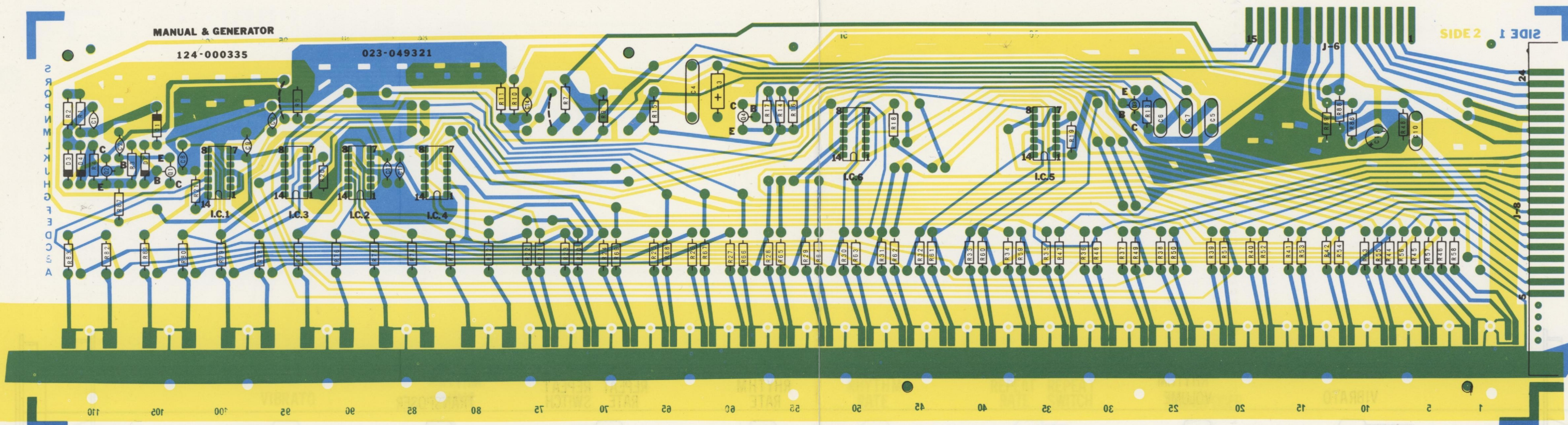




120-000066-0

FIGURE 3-2  
CONTROL PANEL ASSEMBLY  
WIRING DIAGRAM





## MANUAL AND GENERATOR BOARD

The Manual and Generator Board #124-000335 contains circuitry to generate three octaves of staired frequencies, 37 contacts by which the frequencies are keyed, a vibrato oscillator, and a transposer circuit.

The generator consists of a multivibrator-type master oscillator driving an MDD top octave system. The remaining 25 frequencies are supplied by four integrated circuit divider packages. Because the output waveforms of the two MDD integrated circuit packages have duty cycles of 30%, odd and even harmonics are present and stairstepping is not required for the top octave frequencies. The outputs of the seven-stage divider packages are square waves, and thus stairstepping of the lowest 25 frequencies is necessary to obtain even harmonics. A single resistor is associated with each of the top twelve frequencies (top octave)

and is in series with a contact which, when depressed, applies the frequency to the signal buss. Similarly, a resistor is placed in series between each of the lowest 25 frequencies and its respective contact; in addition, each of the lowest 25 frequencies has a second resistor connected between its contact and the output of the generator one octave higher. To prevent sub-harmonics from appearing in any of the top 25 frequencies, two-pole contacts are used for the lowest 25 frequencies to isolate the fundamental frequencies from their stairstepping frequencies whenever the contact is not depressed.

The 37 contacts are printed on the board. They consist of two adjacent strips of copper (or three strips for the double pole switches used in the lowest 25 frequencies as mentioned in the above paragraph). The copper contacts are gold plated, and con-

tact is made when pressure from an external source (such as an actuator on a key) is applied to the strip of conductive elastomer located above the row of contacts.

The vibrato oscillator is a phase-shift type with fixed frequency. The output of the vibrato oscillator is used to vary the frequency of the master oscillator at the vibrato rate. The vibrato width is controlled by adjustment of a potentiometer external to the printed wiring board.

The master oscillator is designed so that its frequency is adjustable over a range of at least an octave by means of a potentiometer external to the printed wiring assembly. In a similar manner, the oscillator may be detuned by one semitone momentarily (for portamento) by applying a voltage to the master oscillator.

FIGURE 3-3  
MANUAL AND GENERATOR BOARD  
LAYOUT AND THEORY  
(124-000335)



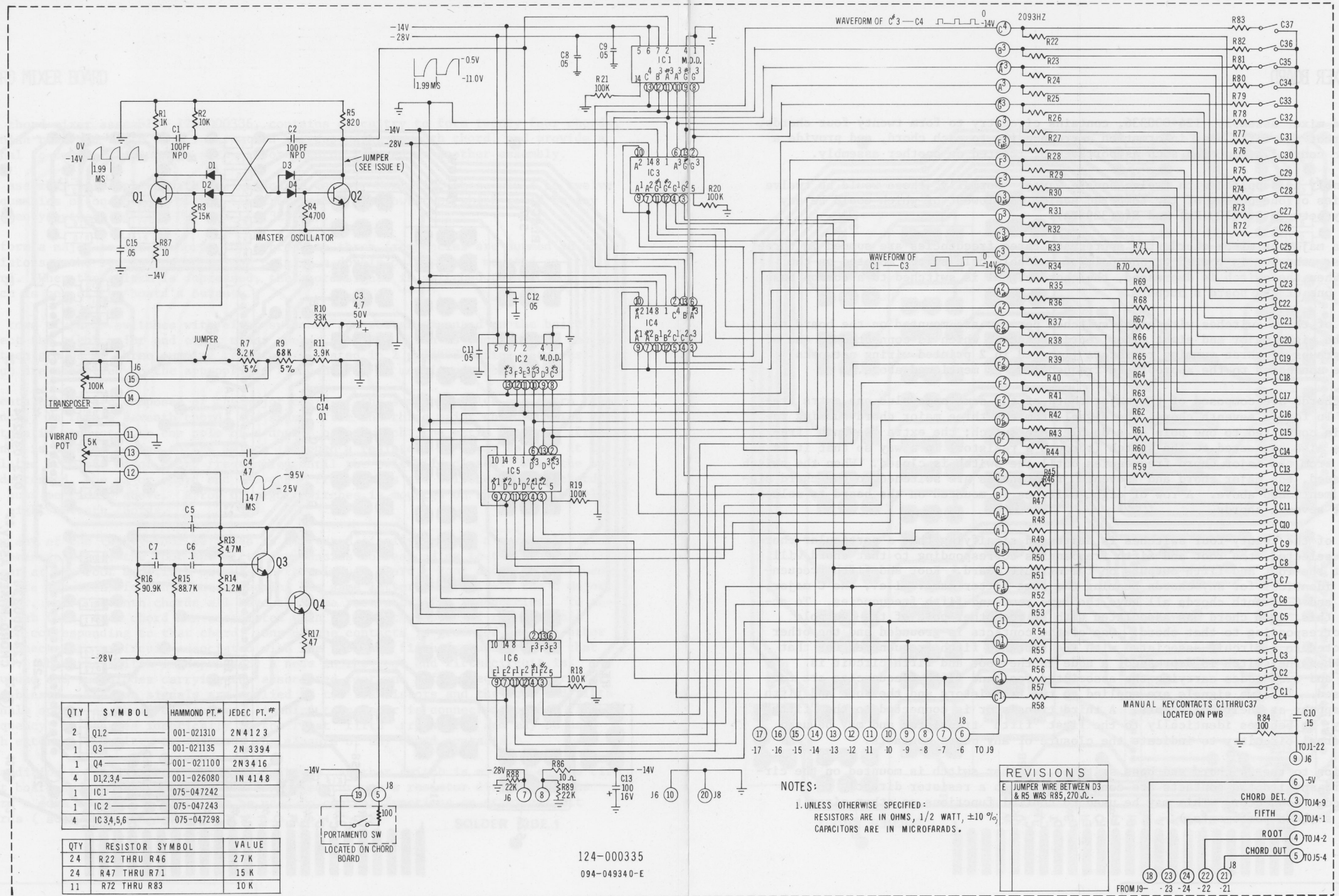


FIGURE 3-4  
MANUAL AND GENERATOR BOARD  
SCHEMATIC  
(124-000335)

## CHORD MIXER BOARD

The chord mixer assembly, 124-000336, contains circuitry to form twenty-four chords, furnish root and fifth bass information corresponding to each chord, and provide a signal to control a function such as portamento, located on another assembly.

The assembly is supplied with twelve square waves. Normally, these would be twelve frequencies of one octave of the tempered scale, the lowest of which could be any frequency between G# (103 Hz) and E# (329 Hz).

To form a major or minor chord, the appropriate three frequencies are summed in three resistors: the sum is routed to one pole of a double pole switch mounted on the board. When the switch is depressed, the chord signal is switched to a common buss, which is one of the board's outputs.

Two rows of these switches with eight switches per row are mounted on the board to select the eight major and eight minor chords, each of which is connected to one of sixteen groups of three summing resistors (located in 2 printed wiring networks) which are connected to the appropriate frequencies, as mentioned above.

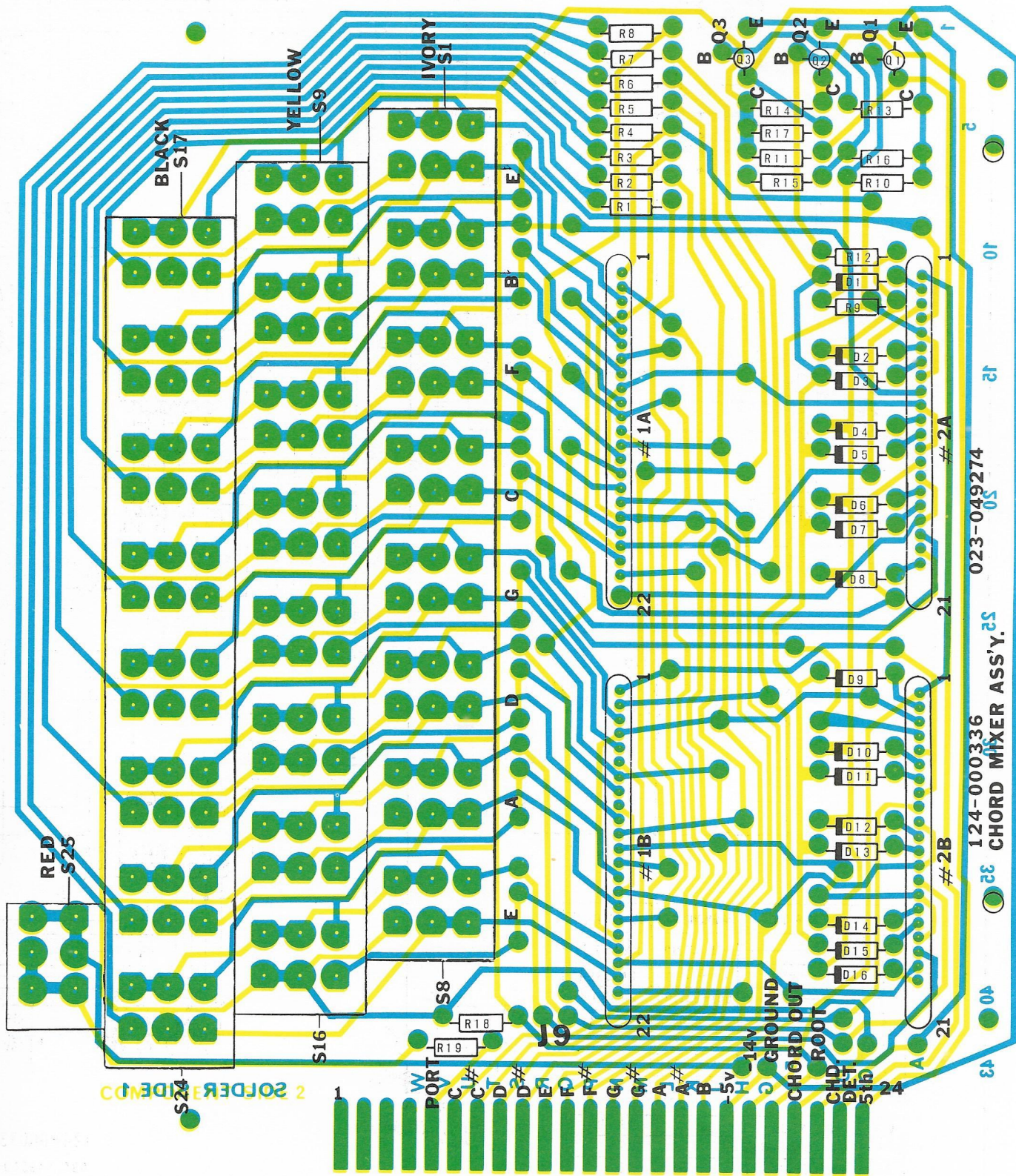
Seventh chords are composed of the major chord of the same name plus one extra frequency. To form a seventh chord, the signal from the three major chord summing resistors is connected to one pole of a double pole switch; the extra "seventh" frequency is also connected to the switch (through a resistor) in a way so that it is isolated from the major chord frequencies until the switch is closed. When the switch is depressed, the major chord and "seventh" frequencies are switched to the chord signal buss mentioned above. A row of eight switches is mounted on the board to select the eight seventh chords.

When any of the twenty-four switches is depressed signifying that a particular chord has been selected, the root and fifth frequencies corresponding to that chord will appear at the root and fifth outputs on the circuit board. Root and fifth frequencies are identical for any chords bearing the same letter name: i.e., the C major, C minor, and C seventh chords all have the same root and fifth frequencies. To accomplish this, each chord has associated with it the other pole of the two pole switch corresponding to that chord. One of the contacts is grounded and the other is connected to a circuit associated with the root and fifth frequencies for that chord. When the switch is depressed, a node in the root and fifth circuit is grounded and two diodes carrying the associated root and fifth frequencies are forward biased. The two signals are applied to two transistors and the root and fifth signals appear at their collectors. A third transistor is connected to the "fifth" frequency; it behaves identically to the first "fifth" transistor and may be used with external circuitry to indicate the closure of any chord contacts.

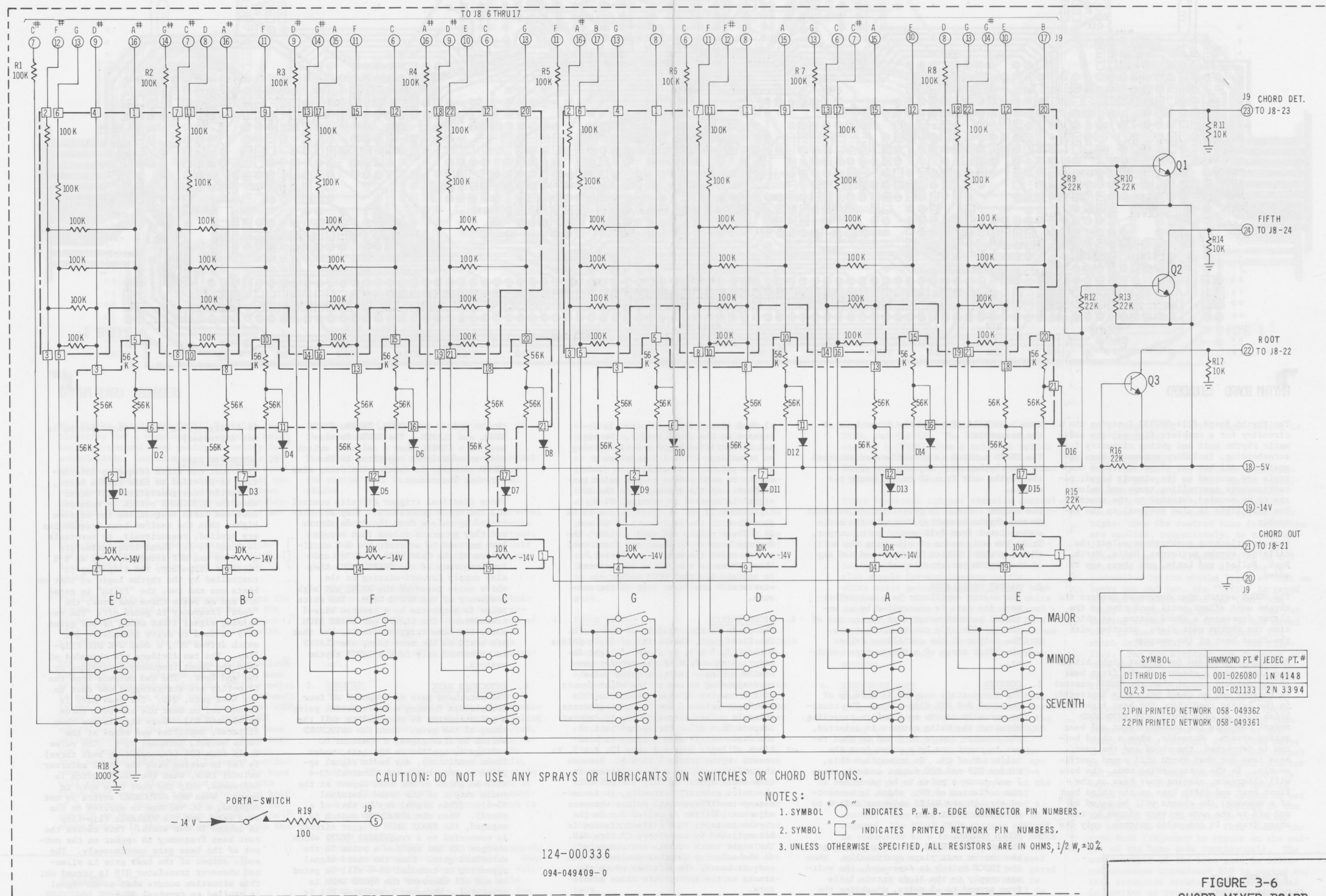
In addition to the 24 chord and bass switches, another switch is mounted on the circuit board and its two contacts are connected through a resistor directly to the board's edge connector. This may be used to control functions on other circuit boards ( such as portamento ).

FIGURE 3-5  
CHORD MIXER BOARD  
LAYOUT AND THEORY  
(124-000336)

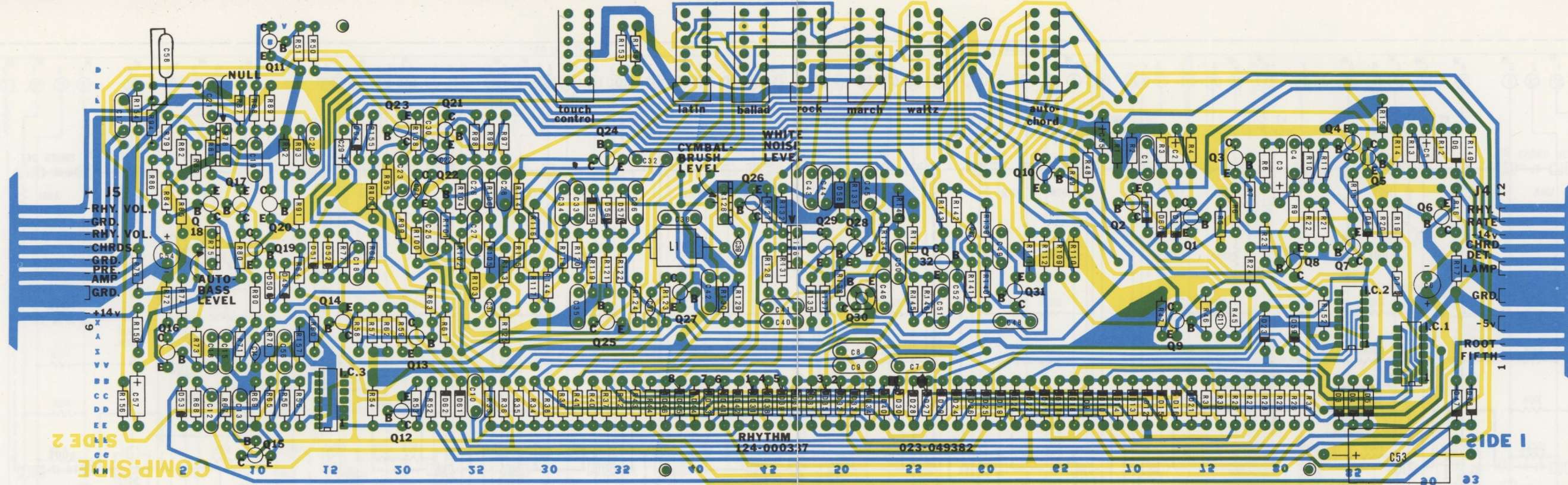












RHYTHM BOARD (SOUNDER)

The Rhythm Board #124-000337 Contains the circuitry for a complete five-pattern automatic rhythm unit and gating circuitry for autochording, including automatic bass operation. All but two player-operated controls are mounted on the circuit board; potentiometers controlling tempo and volume are to be mounted external to the assembly. The beat light is also external to the assembly.

Five interlocking pushbuttons select the different rhythm patterns: Waltz, March, Rock, Ballad, and Latin, and these may be added.

The TOUCH switch when depressed renders the rhythm unit silent until such time as the player depresses a chord button, at which time the rhythm unit plays, starting with the first beat of the measure.

The signal provided for a beat light, blinks the light once a measure on the first beat of the measure except when the TOUCH control is engaged and no chord button is depressed; in the latter condition, the beat light will blink once on each beat. The AUTOCHORD switch controls the accompaniment and bass gating system. Normally, when a chord button is depressed, the chord and the root bass tone for that chord will sound continuously. In the autochording mode, the bass will alternate, playing root bass on the first beat and fifth bass on the third beat of a measure; the chords will be gated on and off in the same pattern played by the snare drum. In the waltz pattern, only the

root bass will play (on the first beat of the measure).

The TEMPO control (a potentiometer external to the rhythm unit) adjusts the speed of the rhythm unit from 40 to 450 beats per minute.

The VOLUME control (a potentiometer external to the rhythm assembly) controls the audio output level from full output to no output. It is the only means of silencing the unit when any chord button is depressed and any of the rhythm patterns is selected.

#### 1. MASTER OSCILLATOR

The master oscillator is a multivibrator; its rate is controlled by an external potentiometer that varies one of the oscillator's two time constants. The output of the oscillator drives the first stage of a three-stage counter.

#### 2. COUNTER

The three-stage counter is made up of two dual J-K DTL flip-flops. The counter normally counts to 8 before recycling. Whenever the Waltz pattern is selected, the counter counts to 6 and is then reset to count one by a pulse from the collector of Q9. To accomplish this, diodes D23 and D30 detect counter state 7 and cause a pulse to be generated at the collector of Q9, which is connected through the WALTZ selector switch to a counter reset pin.

#### 3. TOUCH CONTROL

Whenever the TOUCH switch is disengaged, the rhythm unit plays continually. When the TOUCH switch is depressed, the voltage supply to the diode matrix falls from ground to -5 volts, disabling the diode matrix and thus preventing pulses from triggering the voice generators. When an AC signal is applied to termin-

al J4-9 (i.e., a chord button is depressed on the chord board), the signal is rectified by D6 and C5, turning on transistor Q5, which supplies a ground potential to enable the diode matrix to send pulses to the voice generators. At the instant when the AC signal is applied to terminal J4-9, capacitors C3 and C4 cause pulses to be generated at the collectors of Q3 and Q4. These pulses are used to reset the 3-stage counter to count one (beat one) and to reset the master oscillator. Thus, whenever the rhythm unit starts to operate (in the TOUCH mode), it starts with the first beat of the measure.

#### 4. DIODE MATRIX

The diode matrix consists of two parts. The first part, consisting of logic points 8 thru 13, 2 & 3, is a one of eight decoder; each output of the decoder generates a single positive-going pulse corresponding to one of the eight counts of the counter (the exceptions to this are logic points 2 and 3, which generate multiple pulses corresponding to counter outputs Q1 & Q2). The second part of the diode matrix adds various combinations of logic points 8 thru 13, 2 & 3, to create rhythm tracks 1 thru 8. Because the addition of two pulses adjacent in time would appear as only one pulse to the voice generator circuits, it is necessary to differentiate pulses whenever adjacent addition is called for in the rhythm pattern; this differentiation is accomplished by capacitors C7 thru C10. The eight track outputs are connected to the selector switches mounted on the circuit board; the switches route the tracks to the appropriate voice generators.

#### 5. VOICE GENERATORS

There are four voice generators in the

rhythm unit: BASS DRUM, BRUSH, SNARE DRUM, and CLAVES. The BRUSH is also used as a CYMBAL when a selector switch adds an additional capacitor to the BRUSH circuit, increasing the decay time for that instrument.

Three identical trigger circuits control all the voice generators. They are activated by pulses from the diode matrix and they generate pulses that supply base current to activate the R-C oscillators of the BASS DRUM, CLAVES, and low frequency of the SNARE DRUM; they also supply forward-biasing to the white noise gates of the BRUSH and high frequency of the SNARE DRUM. The white noise is generated by a reverse biased transistor. The CLAVES and SNARE DRUM share the same trigger circuit, and thus are heard at the same time; the CLAVES is connected only in the LATIN rhythm pattern.

#### 6. AUTOCHORD GATE

The autochord gate is composed of four transistors forming a differential pair; a potentiometer is provided to null the thump of the gate. When the AUTOCHORD switch is disengaged, a constant DC voltage is applied to the gate; under these conditions, any audio signal applied to edge connector terminal J5-4 will be gated on and will appear at the audio output of the board (terminal J5-6). (This signal may be that of a chord). When the AUTOCHORD switch is engaged, the SNARE DRUM trigger circuit is connected to a transistor (Q23) which charges C29 and applies a pulse to the autochord gate. Thus the chord signal appearing on terminal J5-4 will be gated on and off whenever the SNARE DRUM is triggered. Whenever transistor Q11 is turned on, the output of the autochord gate is silenced; this occurs when the AC signal is not present on terminal

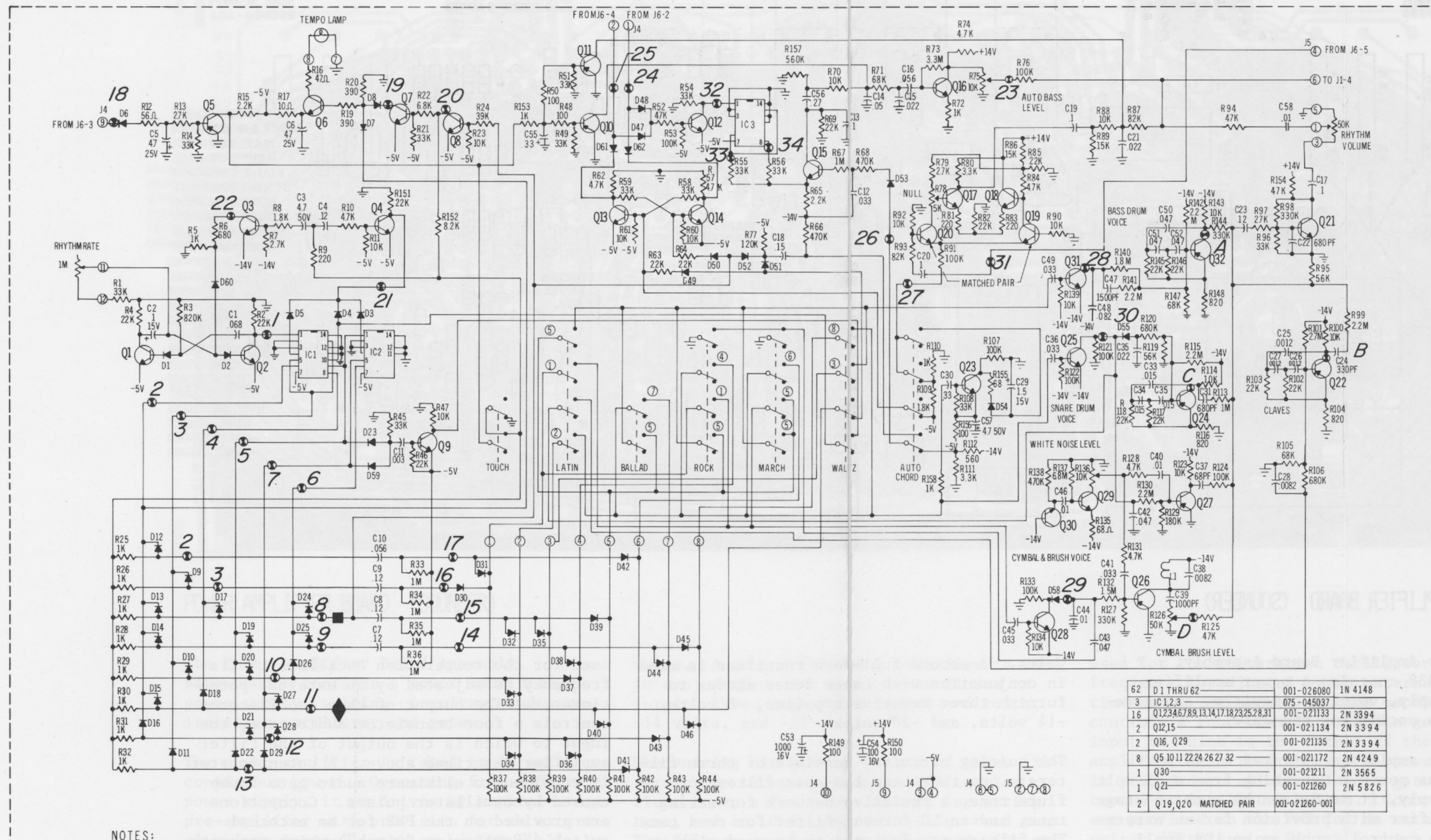
J4-9 (signifying that a chord button is not depressed).

#### 7. AUTOMATIC BASS

When root and fifth frequency information is provided to this rhythm board, automatic bass generation will occur when the AUTOCHORD switch is engaged. Root and fifth frequencies two octaves higher than the desired bass frequencies are applied, respectively, to terminals J4-2 and J4-1. These frequencies are gated on and off alternately by an R-S bistable flip-flop; the flip-flop is controlled by the rhythm logic so that on beats one and two, the "fifth" is gated off and on beats three and four, the "root" frequency is gated off. The remaining signal (that which is not gated off) is used to drive transistor Q12 which drives IC3, a dual J-K DTL Flip-flop. The two dividers are cascaded so that the input frequency is divided by two and four. The two outputs from the flip-flop are stairstepped and sent to the bass gate, Q15. The bass gate is turned on, on beat one and beat three by D51 and D52. Bass signals are then filtered, amplified and mixed at the audio output, terminal J5-6. The pulse train from D51 (representing beat three) is fed in series with the WALTZ selector switch; thus, when the WALTZ switch is depressed, only the root bass note is heard. When the AUTOCHORD switch is not engaged, a DC voltage is applied to the bass gate, and the bistable flip-flop is locked in one state. This causes the root bass frequency to appear on the output of the bass gate continuously. The audio output of the bass gate is silenced whenever transistor Q10 is turned on; this situation occurs when no AC signal is applied to terminal J4-9.

FIGURE 3-7  
RHYTHM BOARD A  
LAYOUT AND THEORY  
(124-000337)





NOTES:  
 1. IF OTHERWISE NOT SPECIFIED:  
 ALL RESISTORS ARE IN OHMS 1/2 W, ±10 %;  
 ALL CAPACITORS ARE IN MICROFARADS.

124-000337  
 094-049316-H

62	D1 THRU 62	001-026080	1N 4148
3	IC1,2,3	075-045037	
16	Q12,34,6,7,8,9,13,14,17,18,23,25,28,31	001-021133	2N 3394
2	Q12,15	001-021134	2N 3394
2	Q16, Q29	001-021135	2N 3394
8	Q5,10,11,22,24,26,27,32	001-021172	2N 4249
1	Q30	001-021211	2N 3565
1	Q21	001-021260	2N 5826
2	Q19, Q20 MATCHED PAIR	001-021260-001	

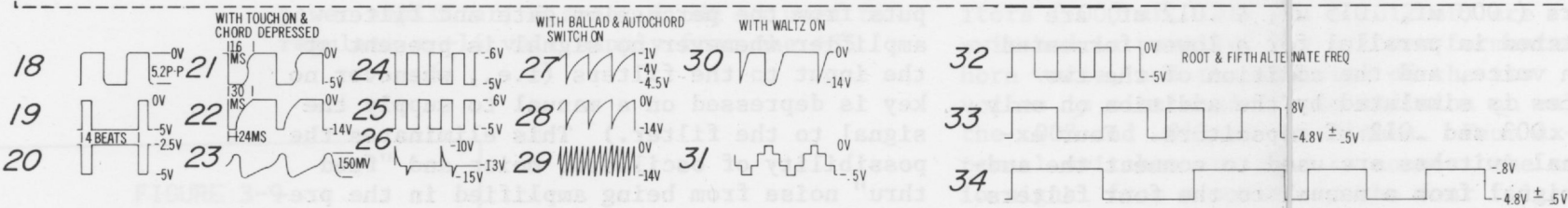
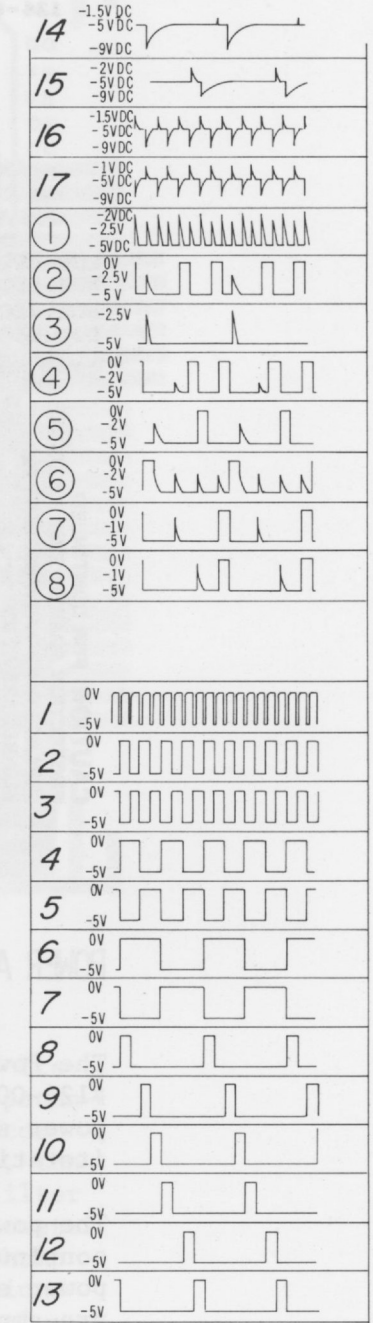
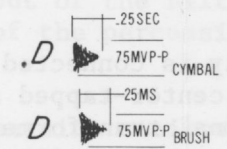
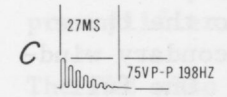
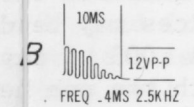
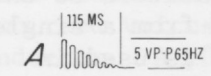
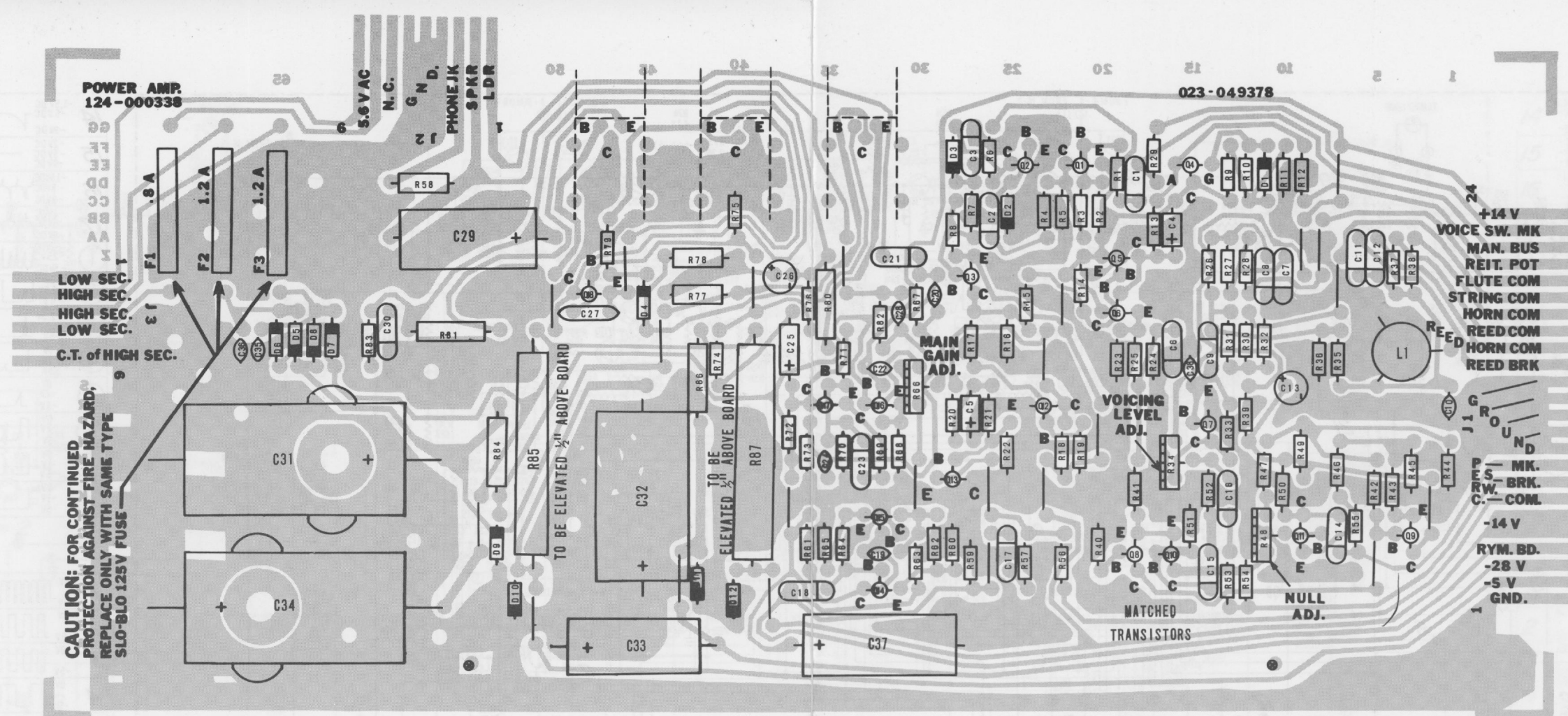


FIGURE 3-8  
 RHYTHM BOARD SCHEMATIC  
 (124-000337)





## POWER AMPLIFIER BOARD (SOUNDER)

The Power Amplifier Board Assembly, #124-000338 contains a power amplifier, power supply, voicing circuitry, and a reiteration oscillator and gate.

The power amplifier is rated at 10 watts continuous power. Operating from a 35 volt power supply, it is driven by a three-stage pre-amplifier with provision for an external volume control, such as an LDR swell pedal.

The power supply is connected to the three outputs of the center-tapped secondary winding of an external transformer. One full-wave rectifier supplies +35 volts for the power amplifier; a zener diode is used to regulate a +14 volt supply from the +35

volts. A second full-wave rectifier is used in conjunction with three zener diodes to furnish three negative supplies, -5 volts, -14 volts, and -28 volts.

The voicing circuitry consists of three filters: one two-stage low-pass filter for flute tone, a resistive network for string tone, and an LC formant filter for reed tone. The filters are designed to be used with an input of stairsteped square waves. The formant filter includes three capacitors so that two reed voices may be derived from a single inductor. A .003 uf capacitor is used in parallel with the one henry coil to create a high formant for a reed voice. Three capacitors (.003 uf, .015 uf, & .012 uf) are switched in parallel for a lower formanted horn voice, and the addition of the two voices is simulated by the addition on only the .003 and .012 uf capacitors. Four external switches are used to connect the audio signal from a manual to the four filters. A single-stage amplifier follows the filters to raise the signal level.

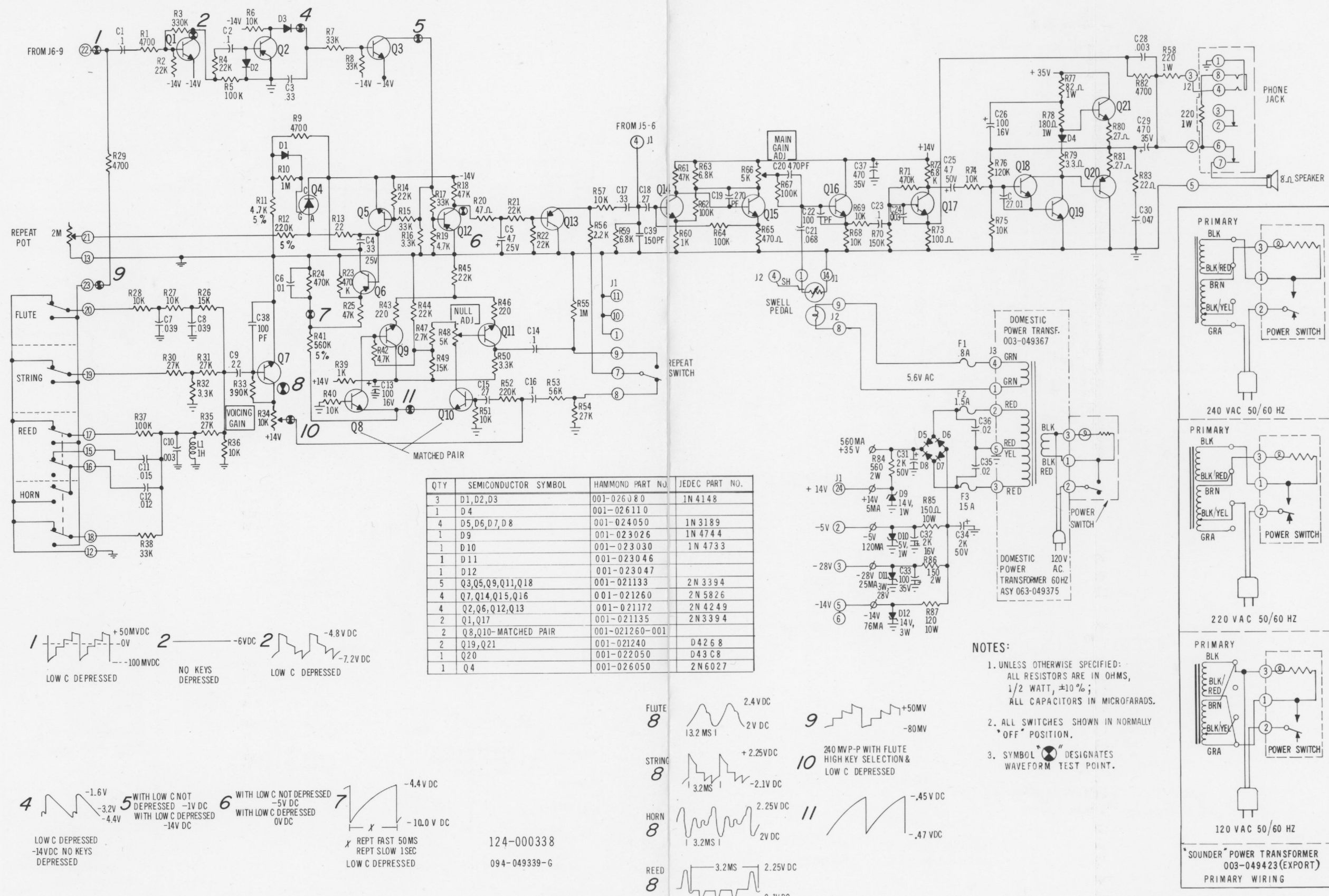
A programmable unijunction transistor is

used for the reiteration oscillator. Its frequency is adjusted by an external potentiometer. The output of this oscillator controls a four-transistor audio gate, the input to which is the output of the filter amplifier described above. A potentiometer is provided to eliminate audio gate thump caused by oscillator pulses. Connections are provided on the PWB for an external switch ("Percussion Switch") which connects either the output of the filter amplifier or the output of the percussion gate to the preamplifier.

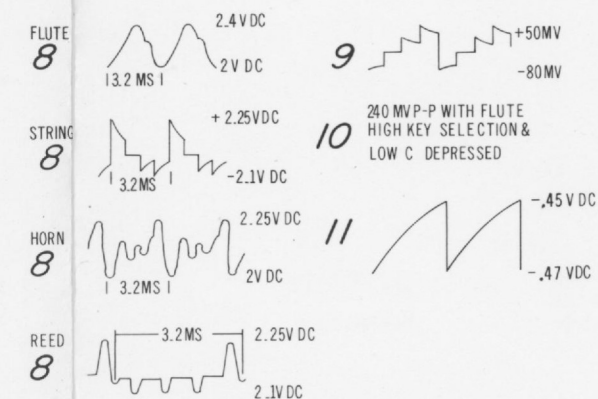
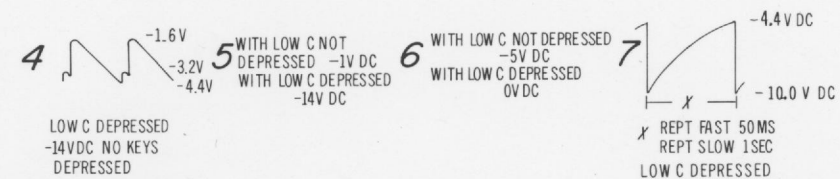
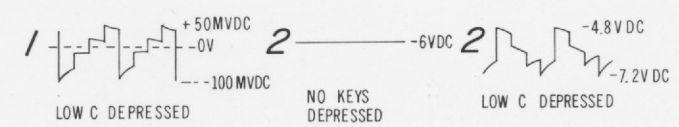
The PWB also contains a circuit to stop the reiteration oscillator and gate off the outputs from the percussion gate and filter amplifier whenever no signal is present at the input to the filters (i.e., whenever no key is depressed on a manual to supply the signal to the filter.) This eliminates the possibility of oscillator noise and "feed thru" noise from being amplified in the preamp with no other signal present. The DC signal used to control this gating circuit is obtained by amplifying and rectifying the filter input signal.

FIGURE 3-9  
POWER AMPLIFIER  
LAYOUT AND THEORY  
(124-000338)





QTY	SEMICONDUCTOR SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
3	D1, D2, D3	001-026080	1N4148
1	D4	001-026110	
4	D5, D6, D7, D8	001-024050	1N3189
1	D9	001-023026	1N4744
1	D10	001-023030	1N4733
1	D11	001-023046	
1	D12	001-023047	
5	Q3, Q5, Q9, Q11, Q18	001-021133	2N3394
4	Q7, Q14, Q15, Q16	001-021260	2N5826
4	Q2, Q6, Q12, Q13	001-021172	2N4249
2	Q1, Q17	001-021135	2N3394
2	Q8, Q10 - MATCHED PAIR	001-021260-001	
2	Q19, Q21	001-021240	D4268
1	Q20	001-022050	D43C8
1	Q4	001-026050	2N6027



- NOTES:
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, 1/2 WATT,  $\pm 10\%$ ; ALL CAPACITORS IN MICROFARADS.
  2. ALL SWITCHES SHOWN IN NORMALLY "OFF" POSITION.
  3. SYMBOL DESIGNATES WAVEFORM TEST POINT.

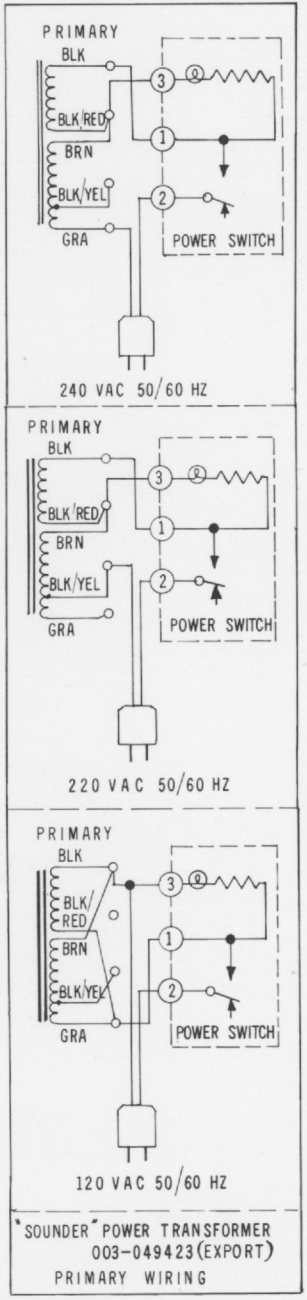


FIGURE 3-10  
POWER AMPLIFIER SCHEMATIC  
(124-000338)

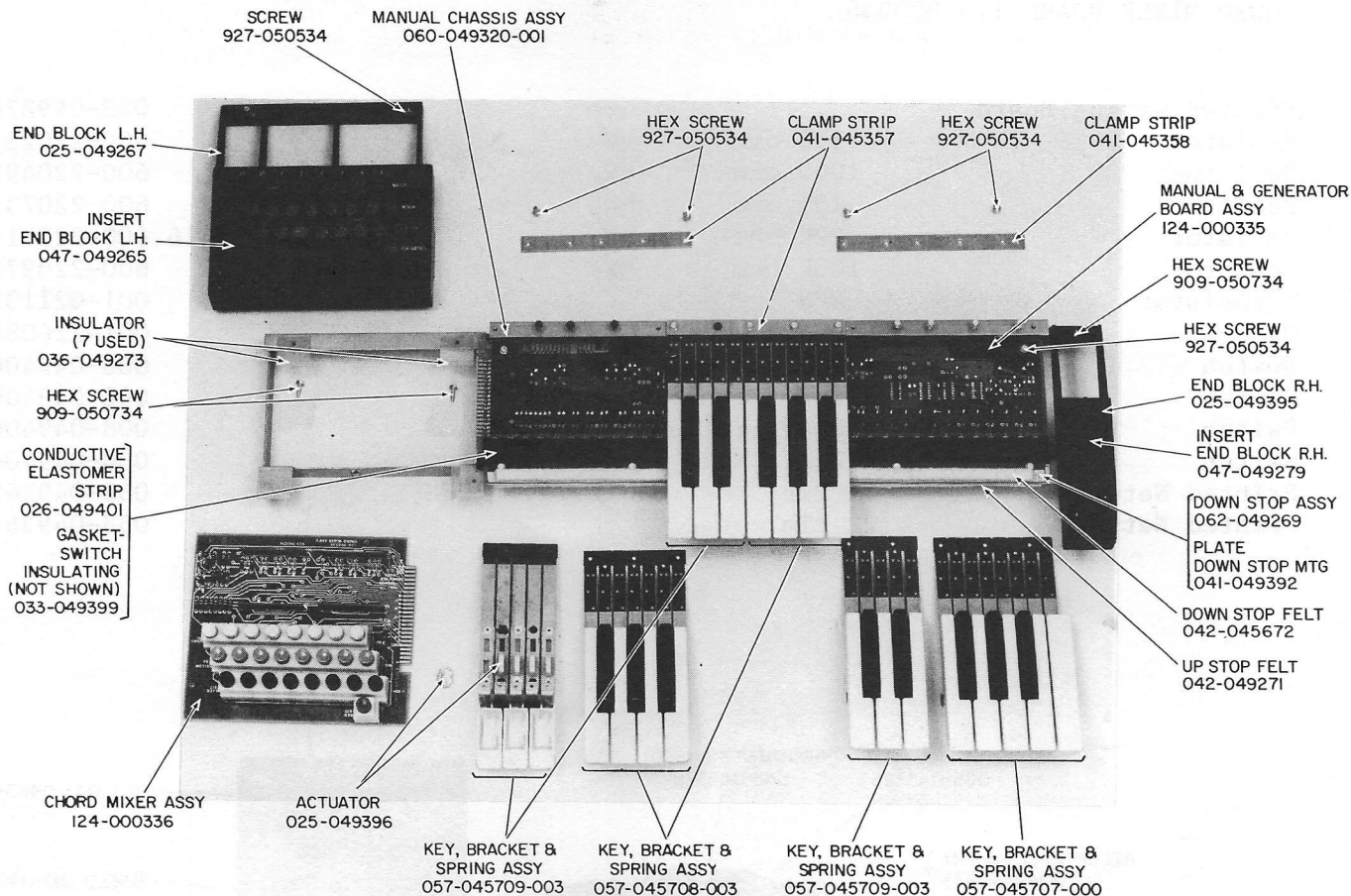


## SECTION IV PARTS LIST

### SOUNDER - 100110 INDEX

<p>CONSOLE (FRONT VIEW) . . . . . page 4-2</p> <p>Top Panel Assembly</p> <p>Music Panel Assembly</p> <p>Chord Mixer Assembly (124-000336)</p> <p>Front Strip</p> <p>Panel &amp; Grill Cloth Assembly</p> <p>Control Panel</p> <p>End Blocks</p> <p>Phone Jack (stereo)</p> <p>Leg Assembly</p> <p>Glide</p> <p>Swell Pedal</p> <p>Bench (Not Shown)</p> <p>UPPER CONSOLE (FRONT VIEW) . . . . . 4-2</p> <p>Top Panel Assembly</p> <p>Trim Strip</p> <p>Control Panel (only)</p> <p>Control Panel (insert)</p> <p>Tab Switch Assembly</p> <p>Logo Insert</p> <p>Slide Potentiometer &amp; Knob</p> <p>Lamp Assembly</p> <p>A.C. Line Switch</p> <p>Player Guide</p> <p>MANUAL &amp; CHORD BUTTON ASSEMBLY. . . 4-3</p> <p>End Block (Left-hand)</p> <p>End Block Insert (Left-hand)</p> <p>Chord Mixer Assembly (124-000336)</p> <p>Manual Chassis Assembly</p> <p>Manual &amp; Generator Bd.(124-000335)</p> <p>Conductive Elastomer Strip</p> <p>Switch Gasket</p> <p>Actuator</p> <p>Key &amp; Spring Assembly (Modules)</p> <p>End Block and Insert (Right-hand)</p> <p>Up and Down Stop Felts</p>	<p style="text-align: right;">page</p> <p>SWELL PEDAL ASSEMBLY. . . . . 4-4</p> <p>Plug &amp; Cable Assembly</p> <p>Bulb and Diffuser</p> <p>Photo Cell</p> <p>Shutter</p> <p>Shutter Spring</p> <p>Socket and Cable Assembly</p> <p>Pedal and Mat Assembly</p> <p>CONSOLE (REAR VIEW) . . . . . 4-5</p> <p>Rhythm Board Mounting Bracket</p> <p>Power Transformer Assembly</p> <p>Phone Jack Assembly</p> <p>Swell Pedal Assembly</p> <p>Line Cord Assembly</p> <p>Rear Cover (Back)</p> <p>Rhythm Board Assembly (124-000337)</p> <p>Speaker</p> <p>UPPER REAR VIEW . . . . . 4-5</p> <p>Control Panel Bracket</p> <p>Transformer Assembly</p> <p>Power Amplifier Board (124-000338)</p> <p>Brackets (Rhythm Board Mounting)</p> <p>Cable and Plug Assemblies</p>
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#### MANUAL & GENERATOR BOARD ASSEMBLY 124-000335

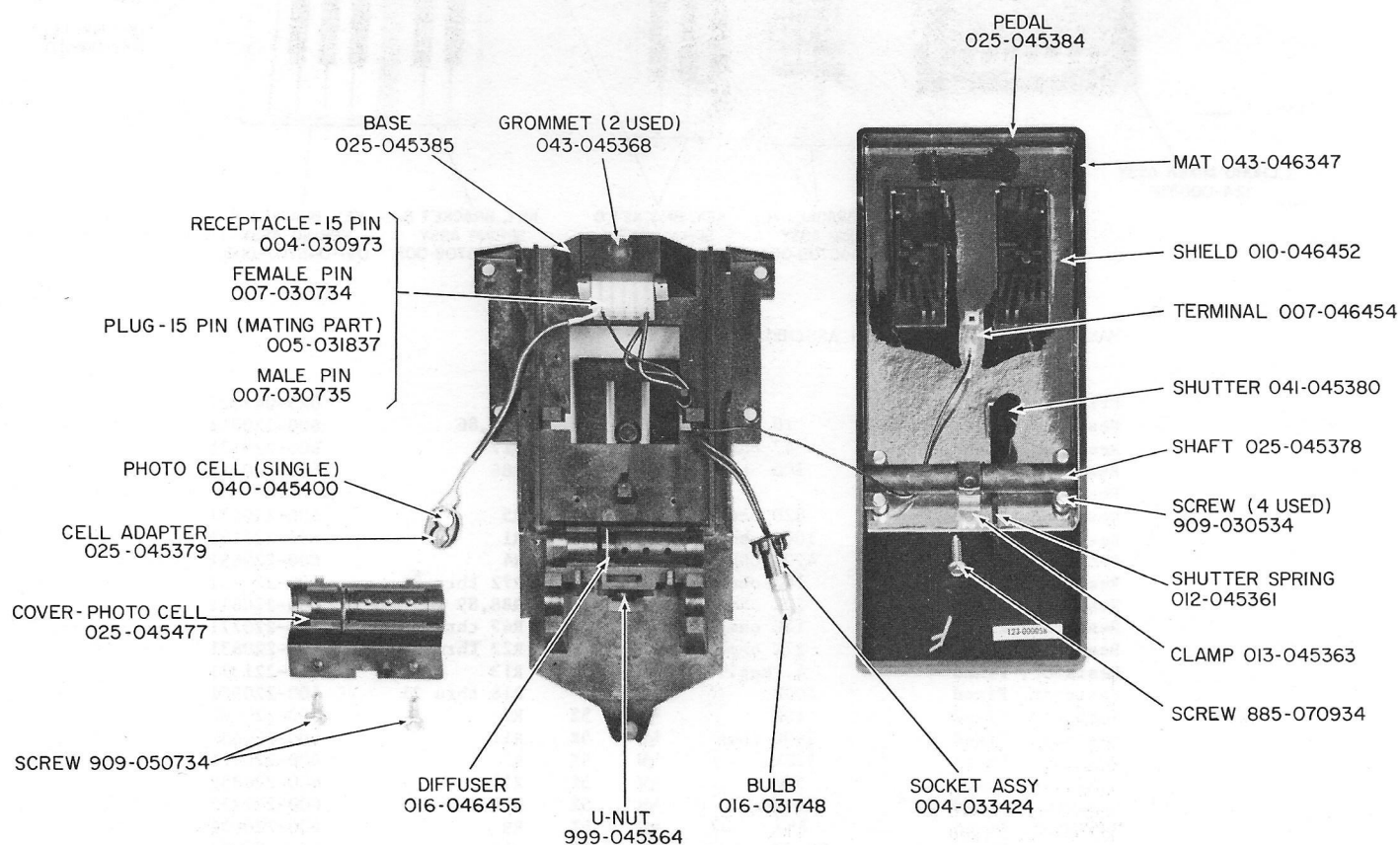
##### Printed Wiring Board

Resistor, Fixed	10 ohms	$\frac{1}{2}W$	R87,86	023-049321
Resistor, Fixed	47 ohms	$\frac{1}{2}W$	R17	600-220011
Resistor, Fixed	100 ohms	$\frac{1}{2}W$	R84	600-220171
Resistor, Fixed		$\frac{1}{2}W$		600-220251
Resistor, Fixed	820 ohms	$\frac{1}{2}W$	R5	600-220471
Resistor, Fixed	1000 ohms	$\frac{1}{2}W$	R1	600-220491
Resistor, Fixed	4700 ohms	$\frac{1}{2}W$	R4	600-220651
Resistor, Fixed	10K ohms	$\frac{1}{2}W$	R72 thru 83	600-220731
Resistor, Fixed	22K ohms	$\frac{1}{2}W$	R88,89	600-220811
Resistor, Fixed	15K ohms	$\frac{1}{2}W$	R47 thru 71,R3	600-220771
Resistor, Fixed	27K ohms	$\frac{1}{2}W$	R22 thru 46	600-220831
Resistor, Fixed	4.7Meg.	$\frac{1}{2}W$	R13	600-221371
Resistor, Fixed	100K	$\frac{1}{2}W$	R18 thru 21	600-220971
Resistor, Fixed	10K	$\frac{1}{2}W$	R2	600-220732
Resistor, Fixed	3900 ohms	$\frac{1}{2}W$	5% R11	600-220632
Resistor, Fixed	8.2K	$\frac{1}{2}W$	5% R7	600-220712
Resistor, Fixed	33K	$\frac{1}{2}W$	5% R10	600-220852
Resistor, Fixed	1.2Meg.	$\frac{1}{2}W$	5% R14	600-221232
Resistor, Fixed	68K	$\frac{1}{2}W$	5% R9	600-220932
Resistor, Fixed	88.7K	$\frac{1}{2}W$	1% R15	625-220033
Resistor, Fixed	90.9K	$\frac{1}{2}W$	1% R16	625-220023
Capacitor, Mylar	0.10MF	5%	C5,6,7	412-110521
Capacitor, Mylar	0.15MF		C10	412-110642
Capacitor, Mylar	0.47MF		C4	412-110562
Capacitor, Ceramic	.01MF		C14	426-010743
Capacitor, Ceramic	.05MF		C8,9,11,12,15	427-170095
Capacitor, Ceramic	100PF		C1,2	426-010251
Capacitor, Electrolytic	4.7MF/50V		C3	431-056509
Capacitor, Electrolytic	100MF/16V		C13	432-107159
Integrated Circuit			IC1	075-047242
Integrated Circuit			IC2	075-047243
Integrated Circuit			IC3 thru 6	075-047298
Diode			D1 thru 4	001-226080
Transistor (NPN)			Q4	001-021100
Transistor (NPN)			Q3	001-021135
Transistor (NPN)			Q1,2	001-021310
Speed Clip				013-045744
Connector				005-049365
Gasket, Switch Insulating				033-049399
Strip, Conductive Elastomer				026-049401

Printed Wiring Board

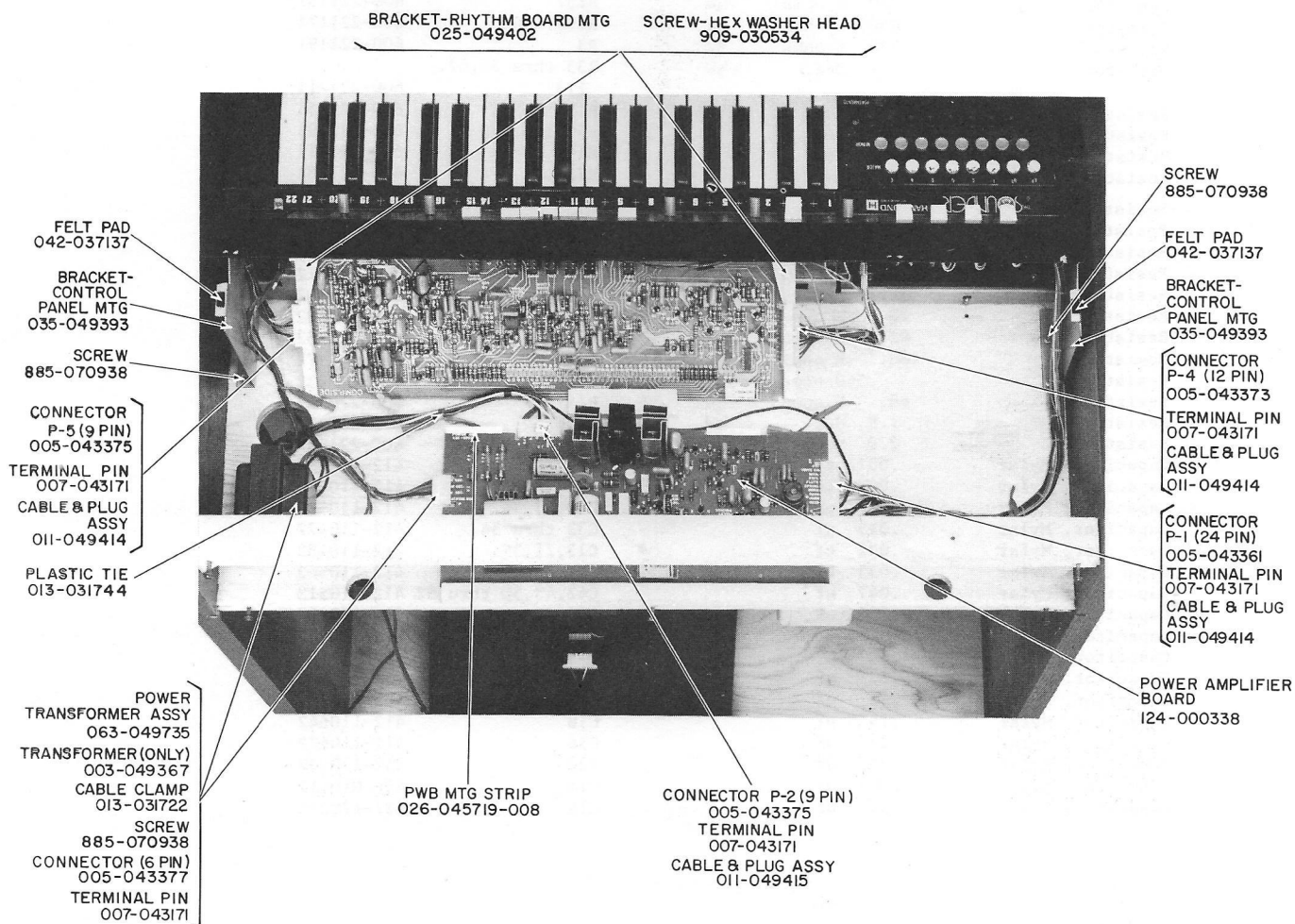
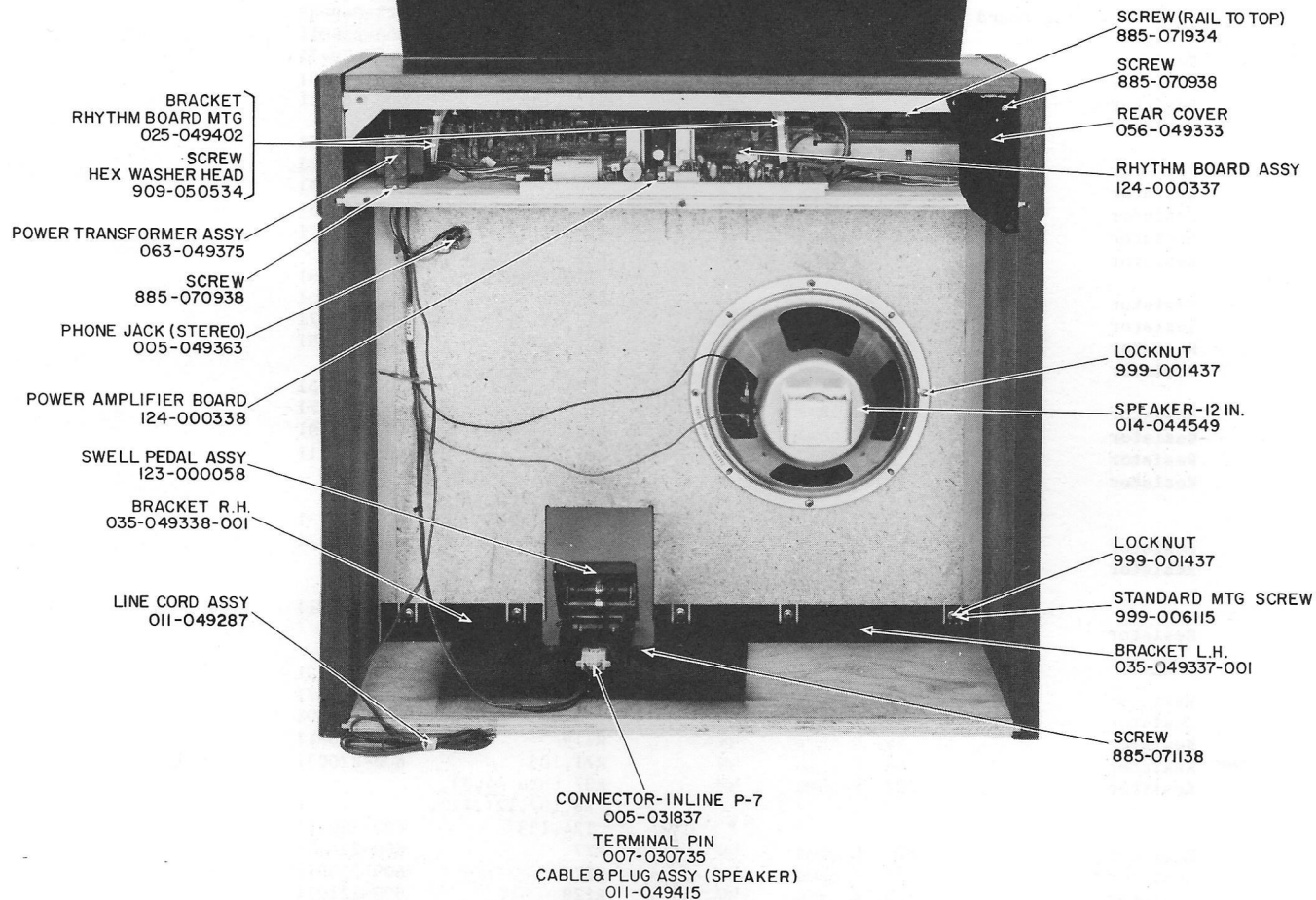
Resistor	100 ohm	$\frac{1}{2}W$
Resistor	1000 ohm	$\frac{1}{2}W$
Resistor	10K ohm	$\frac{1}{2}W$
Resistor	22K ohm	$\frac{1}{2}W$
Resistor	100K ohm	$\frac{1}{2}W$
Transistor	NPN	
Diode		
Switch	8 Pos., Blk.	
Switch	8 Pos., Ivory	
Switch	8 Pos., Yellow	
Switch	1 Pos., Red	
Printed Network	21 Pin	
Printed Network	22 Pin	

R19	023-049274
R18	600-220251
R11,14,17	600-220491
R9,10,12,13,15,16	600-220731
R1 thru 8	600-220811
Q1,2,3	600-220971
	001-021133
	001-226080
	008-049406-001
	008-049406-002
	008-049406-003
	008-049404
	058-049362
	058-049361



Swell Pedal Assembly (Exposed View) I23-000058







## Printed Wiring Board

Resistor	10 ohms	$\frac{1}{2}W$	R17	023-049382
Resistor	47 ohms	$\frac{1}{2}W$	R16	600-220011
Resistor	56 ohms	$\frac{1}{2}W$	R12	600-220171
Resistor	68 ohms	$\frac{1}{2}W$	R135,155	600-220191
Resistor	100 ohms	$\frac{1}{2}W$	R50,48,149,150, 156	600-220211
Resistor	220 ohms	$\frac{1}{2}W$	R9	600-220251
Resistor	390 ohms	$\frac{1}{2}W$	R19,20	600-220331
Resistor	680 ohms	$\frac{1}{2}W$	R6	600-220391
Resistor	820 ohms	$\frac{1}{2}W$	R104,116,148	600-220451
Resistor	1K ohms	$\frac{1}{2}W$	R25 thru 32,72, 110,153,158	600-220471
Resistor	1.8K ohms	$\frac{1}{2}W$	R8,109	600-220491
Resistor	2.2K ohms	$\frac{1}{2}W$	R15,65	600-220551
Resistor	2.7K ohms	$\frac{1}{2}W$	R7,13,79	600-220571
Resistor	4.7K ohms	$\frac{1}{2}W$	R10,57,62,128, 131	600-220591
Resistor	5.6K ohms	$\frac{1}{2}W$	R95	600-220651
Resistor	6.8K ohms	$\frac{1}{2}W$	R22	600-220671
Resistor	8.2K ohms	$\frac{1}{2}W$	R152	600-220691
Resistor	10. K ohms	$\frac{1}{2}W$	R11,23,47,60,61, 70,88,100,114, 123,134,139	600-220711
Resistor	15. K ohms	$\frac{1}{2}W$	R86,89	600-220731
Resistor	22. K ohms	$\frac{1}{2}W$	R2,4,46,63,64,82, 85,102,103,117, 118,145,146,151	600-220771
Resistor	33. K ohms	$\frac{1}{2}W$	R1,14,21,45,49,51, 54,55,56,58,59, 96,108	600-220811
Resistor	39. K ohms	$\frac{1}{2}W$	R24	600-220851
Resistor	47. K ohms	$\frac{1}{2}W$	R52,94,125,154	600-220871
Resistor	56. K ohms	$\frac{1}{2}W$	R119	600-220891
Resistor	68. K ohms	$\frac{1}{2}W$	R71,105	600-220911
Resistor	100. K ohms	$\frac{1}{2}W$	R37 thru 44,53, 76,107,121,122, 124,133	600-220931
Resistor	120. K ohms	$\frac{1}{2}W$	R77	600-220971
Resistor	82. K ohms	$\frac{1}{2}W$	R87	600-220991
Resistor	180. K ohms	$\frac{1}{2}W$	R129	600-221031
Resistor	330. K ohms	$\frac{1}{2}W$	R98,127,144	600-221091
Resistor	470. K ohms	$\frac{1}{2}W$	R66,68,138	600-221131
Resistor	560. K ohms	$\frac{1}{2}W$	R157	600-221151
Resistor	680. K ohms	$\frac{1}{2}W$	R106,120	600-221171
Resistor	820. K ohms	$\frac{1}{2}W$	R3	600-221191
Resistor	1 Meg.	$\frac{1}{2}W$	R33 thru 36,67, 113	600-221211
Resistor	1.5 Meg.	$\frac{1}{2}W$	R132	600-221251
Resistor	2.2 Meg.	$\frac{1}{2}W$	R99,115,130	600-221291
Resistor	2.7 Meg.	$\frac{1}{2}W$	R101	600-221311
Resistor	3.3 Meg.	$\frac{1}{2}W$	R73	600-221331
Resistor	6.8 Meg.	$\frac{1}{2}W$	R137	600-221411
Resistor	27. K ohms	$\frac{1}{2}W$	R97	600-221431
Resistor	220 ohms	$\frac{1}{2}W$	R81,83	600-220831
Resistor	3.3 K ohms	$\frac{1}{2}W$	5% R80,111	600-220332
Resistor	4.7 K ohms	$\frac{1}{2}W$	5% R74,84	600-220612
Resistor	10. K ohms	$\frac{1}{2}W$	R90,92,143	600-220652
Resistor	82. K ohms	$\frac{1}{2}W$	R93	600-220732
Resistor	100. K ohms	$\frac{1}{2}W$	5% R91	600-220952
Resistor	560 ohms	$\frac{1}{2}W$	5% R112	600-220972
Resistor	68. K ohms	$\frac{1}{2}W$	5% R147	600-220432
Resistor	1.8 Meg.	$\frac{1}{2}W$	R140	600-220932
Resistor	2.2 Meg.	$\frac{1}{2}W$	5% R141,142	600-221272
Capacitor, Mylar	.0012 uf		C25 thru 27	600-221292
Capacitor, Mylar	.0082 uf		C28,38	412-110582
Capacitor, Mylar	.01 uf		C40,44,46	412-110602
Capacitor, Mylar	.015 uf		C32 thru 34	412-110462
Capacitor, Mylar	.022 uf		C15,21,35	412-110472
Capacitor, Mylar	.033 uf		C12,36,41,45,49	412-110482
Capacitor, Mylar	.047 uf		C42,43,50 thru 52	412-110502
Capacitor, Mylar	.056 uf		C10,16	412-110512
Capacitor, Mylar	.068 uf		C1	412-110622
Capacitor, Mylar	.082 uf		C48	412-110632
Capacitor, Mylar	.1 uf		C13,17,19,20,58	412-110662
Capacitor, Mylar	.12 uf		C4 thru 9,23	412-110522
Capacitor, Mylar	.15 uf		C18	412-110712
Capacitor, Mylar	.27 uf		C56	412-110642
Capacitor, Mylar	.33 uf		C30	412-110672
Capacitor, Disc	.003 uf		C11	412-110572
Capacitor, Disc	.05 uf		C14	426-010612
				427-170095

Transistor			Q30	001-021211
Transistor			Q21	001-021260
Transistor Socket				004-048898
Potentiometer	5.	K ohms	R78	676-000061
Potentiometer	10.	K ohms	R75,136	676-000064
Potentiometer	50.	K ohms	R126	676-000069
Selector Switch				008-049347
Coil	45	MH	L1	003-030753
Capacitor, Disc	68	PFD	C37	426-010212
Capacitor, Disc	330	PFD	C24	426-010372
Capacitor, Disc	680	PFD	C22,31	426-010462
Capacitor, Disc	1000	PFD	C39	426-010502
Capacitor, Disc	1500	PFD	C47	426-010542
Capacitor, Electrolytic	4.7	MFD/50V	C3,57	431-056509
Capacitor, Electrolytic	47	MFD/25V	C6	432-506259
Capacitor, Electrolytic	100	MFD/16V	C54	432-107159
Capacitor, Electrolytic	1000	MFD/16V	C53	434-108159
Capacitor, Tantalum	1	MFD/15V	C2	414-230092
Capacitor, Tantalum	.33	MFD/15V	C55	414-230042
Capacitor, Tantalum	1.5	MFD/15V	C29	414-230102
Capacitor, Tantalum	4.7	MFD/25V	C5	414-240132
Integrated Circuit, Dual				
JK Flip-Flop			IC1 thru 3	075-045037
Diode			D1 thru 62	001-226080
Transistor			Q1 thru 4,6 thru	
			9,13,14,17,18,	
			23,25,28,31	001-021133
Transistor			Q12,15	001-021134
Transistor			Q16,29	001-021135
Transistor			Q5,10,11,22,24,26,	
			27,32	001-021172
Transistor			Q19,20	001-021260-001

## POWER AMPLIFIER ASSEMBLY 124-000338

Resistor	560K	ohms	$\frac{1}{2}$ W	5%	R41	600-221152
Printed Wiring Board						023-049378
Resistor	22	ohms	$\frac{1}{2}$ W		R13,83	600-220091
Resistor	47	ohms	$\frac{1}{2}$ W		R20	600-220171
Resistor	100	ohms	$\frac{1}{2}$ W		R73	600-220251
Resistor	470	ohms	$\frac{1}{2}$ W		R65	600-220411
Resistor	1K	ohms	$\frac{1}{2}$ W		R39,60	600-220491
Resistor	2.7K	ohms	$\frac{1}{2}$ W		R47	600-220591
Resistor	3.3K	ohms	$\frac{1}{2}$ W		R16,32	600-220611
Resistor	4.7K	ohms	$\frac{1}{2}$ W		R1,19,29,82	600-220651
Resistor	6.8K	ohms	$\frac{1}{2}$ W		R59,63,72	600-220691
Resistor	10K	ohms	$\frac{1}{2}$ W		R6,27,28,36,40,	
					51,68,69,74,	
					75,57	600-220731
Resistor	15K	ohms	$\frac{1}{2}$ W		R26,49	600-220771
Resistor	22K	ohms	$\frac{1}{2}$ W		R2,4,14,21,22,	
					44,45	600-220811
Resistor	27K	ohms	$\frac{1}{2}$ W		R30,31,35,54	600-220831
Resistor	33K	ohms	$\frac{1}{2}$ W		R7,8,15,17,36	600-220851
Resistor	47K	ohms	$\frac{1}{2}$ W		R18,25,61	600-220891
Resistor	56K	ohms	$\frac{1}{2}$ W		R53	600-220911
Resistor	100K	ohms	$\frac{1}{2}$ W		R5,37,62,64,67	600-220971
Resistor	150K	ohms	$\frac{1}{2}$ W		R70	600-221011
Resistor	220K	ohms	$\frac{1}{2}$ W		R52	600-221051
Resistor	330K	ohms	$\frac{1}{2}$ W		R 3	600-221091
Resistor	470K	ohms	$\frac{1}{2}$ W		R23,24,71	600-221131
Resistor	1	Meg.	$\frac{1}{2}$ W		R10,55	600-221211
Resistor	2.2K	ohms	$\frac{1}{2}$ W		R56	600-220571
Resistor	390K	ohms	$\frac{1}{2}$ W		R33	600-221111
Resistor	3.3	ohms	$\frac{1}{2}$ W	5%	R79	600-221542
Resistor	3.3K	ohms	$\frac{1}{2}$ W	5%	R50	600-220612
Resistor	220	ohms	$\frac{1}{2}$ W	5%	R43,46	600-220332
Resistor	4.7K	ohms	$\frac{1}{2}$ W	5%	R11	600-220552
Resistor	220K	ohms	$\frac{1}{2}$ W	5%	R12	600-221052
Resistor	120K	ohms	$\frac{1}{2}$ W	5%	R76	600-220992
Resistor	4.7K	ohms	$\frac{1}{2}$ W	5%	R9,42	600-220652
Resistor	180	ohms	1W		R78	600-030311
Resistor	82	ohms	1W		R77	600-030231
Resistor	220	ohms	1W		R58	600-030331
Resistor, WW	0.27	ohms	2W		R80,81	601-040181
Resistor	150	ohms	2W		R86	600-040291
Resistor	560	ohms	2W		R84	600-040431
Resistor, WW	120	ohms	10W		R87	601-080191
Resistor, WW	150	ohms	10W		R85	601-080201
Capacitor, Ceramic	100	pfd			C22,38	426-010252
Capacitor, Ceramic	270	pfd			C19	426-010352
Capacitor, Ceramic	470	pfd			C20	426-010412
Capacitor, Ceramic	.003	mfd			C10,24,28	426-010612
Capacitor, Ceramic	.02	mfd			C35,36	426-010763
Capacitor, Ceramic	.01	mfd			C27	426-010752
Capacitor, Mylar	.01	mfd			C6	412-110462
Capacitor, Mylar	.012	mfd			C12	412-110612

POWER AMPLIFIER ASSEMBLY 124-000338 (cont'd.)

Capacitor, Mylar	.015 mfd			C11	412-110472
Capacitor, Mylar	.039 mfd			C7,8	412-110652
Capacitor, Mylar	.047 mfd			C30	412-110512
Capacitor, Mylar	.068 mfd			C21	412-110632
Capacitor, Mylar	0.1 mfd			C1,2,14,16,23	412-110522
Capacitor, Mylar	0.27 mfd			C15,18	412-110672
Capacitor, Mylar	0.33 mfd			C3,17	412-110572
Capacitor, Mylar	0.22 mfd			C9	412-110532
Capacitor, Electrolytic	4.7 mfd	50V		C25	431-056509
Capacitor, Electrolytic	100 mfd	16V		C26,13	432-107159
Capacitor, Electrolytic	100 mfd	50V		C33	431-107509
Capacitor, Electrolytic	470 mfd	35V		C29,37	431-507359
Capacitor, Electrolytic	2200 mfd	16V		C32	434-208159
Capacitor, Electrolytic	2000 mfd	50V		C31,34	434-208509
Capacitor, Tantalum	0.33 mfd	25V		C4	414-240042
Capacitor, Tantalum	4.7 mfd	25V		C5	414-240132
Transistor, Sig.	NPN			Q3,5,9,11,18	001-021133
Transistor, Sig.	NPN			Q1, 17	001-021135
Transistor, Sig.	PNP			Q2,6,12,13	001-021172
Transistor, Low Noise	NPN			Q14 thru 16,7	001-021260
Transistor, Med. Pwr.	PNP			Q20	001-022050
Transistor, Med. Pwr.	NPN			Q19,21	001-021240
Transistor, Put				Q4	001-026050
Trimmer Pot	5K ohms			R48,66	676-000061
Trimmer Pot	10K ohms			R34	676-000064
Diode, Zener		5V, 1W		D10	001-223030
Diode, Zener		14V, 1W		D9	001-223026
Diode, Zener		14V, 3W		D12	001-023047
Diode, Zener		28V, 3W		D11	001-023046
Diode, Signal				D1 thru 3	001-226080
Diode, Silicon				D4	001-226110
Rectifier	50 piv, 1A			D5 thru 8	001-224050
Fuse	0.8 A			F1	016-040438
Fuse	1.2 A			F2,3	016-040441
Jumper					299-200004
Screw, 4-40 x 1/4"	Hex. Wash. Hd.				927-030334
Heat Sink					041-049285
Clamp, Capacitor					013-049317
Coil	1 H			L1	003-049346
Transistor				Q8,10	001-021260-001